THE
PRACTICAL ANATOMIST.

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PRACTICAL ANATOMIST:

OR,

THE STUDENT'S GUIDE IN THE DISSECTING-ROOM.

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WITH

TWO HUNDRED AND SIXTY-SIX ILLUSTRATIONS.

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PREFACE.

In preparing a Treatise on Practical Anatomy for the use of medical students, I have not been influenced by the hope that I should be able to add anything new to the fund of knowledge which is to be found in the various works which have been written on anatomy; nor have I expected to be able to introduce much that would be new to any one who has had much experience in teaching practical anatomy.

As our medical institutions are now organized, the student must expect to obtain his knowledge of anatomy from *two distinct sources*—namely, the anatomical theatre, and the dissecting-room. In the *anatomical theatre*, he is taught anatomy after whatever plan is adopted by the Professor of that department in the institution with which he happens to be connected. Here, every part requiring dissection passes through the hands of the Prosector before it is presented to him for his inspection, all the parts not at the time under consideration having been removed. In this way, the student is taught anatomy systematically; he has each system, as the muscular, the vascular, &c., presented to him by itself. He is also provided with what is called a *text-book*, in which he finds everything presented in the same order as in the lecture-room. Thus, in learning anatomy in this way, he is required to do but little more than to listen to what is told him, to observe the illustrations employed by the lecturer, and to read his text-book.

That some parts of anatomy can be taught to better advantage in the anatomical theatre than elsewhere there can be no doubt. But there are other parts that can be learned far better in the *dissecting-room.* Among the parts thus learned may be included almost everything, whose relations must be understood in order to render a knowledge of them available in diagnosis and in operative surgery.

However desirable it may be to have every student become a *thorough anatomist,* it must be well known to every teacher of anatomy that much of what is taught in the lecture-room is never fully learned and retained by very many of those who graduate in our best institutions; nor is it necessary that the practitioner of medicine or surgery should be so thoroughly conversant with the science of anatomy as he who teaches it. Yet no one, I presume, will say that the student should not learn as much of anatomy as is essential to enable him to do justice to those who may confide in his skill or his ability to treat disease. As but few of those who enroll their names in our colleges as students can ever desire or hope to become teachers of anatomy, it is important that their time should be appropriated to the study of what will be indispensable for them to know in the daily routine of practice. Impressed with the conviction that the dissecting-room affords the greatest facilities for acquiring that knowledge which the student, when he becomes a practitioner of medicine, will most need, I have endeavored to supply him with what might be regarded as his *text-book in the dissecting-room.*

To be a student in the *lecture-room* is quite different from being a student in the *dissecting-room.* In the latter, the body is placed in his hands without any previous dissection having been made, and he is required to dissect each part himself. To do this, he must avail himself of the experience of some one who is familiar not only with the parts to be dissected, but with the manipulations necessary to make the proper dissections. In offering him this assistance, I have not viewed

him as a mere passive agent, but as one capable of using his own faculties, and of exercising his own skill and judgment as occasion might require. It has been my constant aim to instil in the dissecting-room a feeling of *self-reliance* and *self-dependence;* to make the student feel that when he had exposed a part, as a muscle, for example, he could see and learn its relations to surrounding parts just as well without as with being told them; that he could see with his own eyes whether a muscle lies on the outer or inner side of a particular artery, and whether it must be divided or not in cutting down upon the latter for the purpose of applying a ligature to it, or whether it may serve as a guide for finding the vessel, and, if so, in what way. In following out this plan, I have, whenever the opportunity offered, suggested what deserved his special attention, believing that a simple suggestion would often be of more value to him than a whole page occupied in describing what a mere hint would prompt him to ascertain or learn without assistance. Whenever I have been able, in the dissecting-room, to make a student feel a consciousness of his own ability to become a good *practical anatomist,* I have almost invariably had the gratification of witnessing his entire *success.* For the truth of this remark, I can appeal to hundreds of gentlemen who are at this time engaged in the active duties of professional life in different portions of the United States.

In the dissecting-room, more than in almost any other place, the student should be encouraged to cultivate a habit of *self-interrogation;* to ask himself the use of everything he dissects, and in what way a knowledge of it can be made available to him, either in understanding the other branches of medical science or in his future practice. To *incite* in his mind such a spirit of self-inquiry has been my constant endeavor throughout the work.

In the division of *a subject,* I have followed the plan which I have found, after a trial of many years, to be the

most convenient and advantageous to students, whose time for studying practical anatomy is limited, and who, not unfrequently, are compelled to confine their dissections to *one* or *two bodies* during the session. The body is supposed to be divided into *five parts*, and apportioned to as many persons; one of whom has the *head* and *neck*, two have, each an *upper extremity* separately, and the *thorax* in common; two have, each a *lower extremity*, including the *abdominal* and *pelvic viscera* between them. It is expected that all will participate in the examination of the parts contained in the three great splanchnic cavities, as they cannot be divided.

Mere *arbitrary rules* for exposing the parts in any region have been, in general, avoided; the position and the relations of each organ or part have indicated the method that has been adopted for dissecting it. Every part in a region has been noticed as it would naturally be met with when the student was desirous of studying everything contained in that region. I have found, that when the attention of a student was directed to the relations of a part as well as to the part itself, the recollection of the one usually aided him in the recollection of the other; that it was merely necessary for him to appropriate more time to the study of the parts of that region.

In aiming to make the book as useful as possible, viewing the student as a candidate for the practice of medicine and surgery, I have not hesitated to discriminate, to some extent, between different regions and organs in a practical point of view; hence, I have dwelt longer on some parts than on others, being governed in this respect partly by what I conceived to be the relative value and importance of the knowledge of any part or organ to the student, and partly by the difficulty which I have observed students in the dissecting-room, especially beginners, to have in dissecting and understanding them. Thus, I have devoted a large share of time and space to the organs contained in the three great splanch-

nic cavities, to the organs of the special senses, and to such regions as the perineum, the inguinal, the femoral, the anterior part of the neck, and the axilla. Although the space allowed in the original plan of the book did not admit of my dwelling long on the medical and surgical anatomy of many parts and regions, I have endeavored to direct the attention of the student to whatever had a practical bearing, so that he could, by referring to works on medicine and surgery, derive full advantage from his dissections. To give merely a *meagre* or *superficial* account of the medical and surgical anatomy of a part, I am satisfied, does the student more harm than good.

There has necessarily been in some places more or less repetition. As the dissector wishes merely to know the position and the relations of a part in the region that he is dissecting, the same part, in some instances, is referred to at different times, and in different dissections.

In regard to illustrations, I need only say that the Publishers gave me *carte-blanche* to select from the whole number of drawings contained in the various works which have been published by them. When the value of these illustrations—over *two hundred* and *sixty* in number—is considered, I am confident that the liberality thus manifested by them will be duly appreciated by every one who may avail himself of the work. There is no Dissector, as far as my knowledge extends, which is so fully illustrated as this; it is hardly possible to over-estimate the value of pictorial illustrations in a work on practical anatomy. I may be permitted to say that the Publishers have spared no expense to make the work, as far as it depended on them, in every way acceptable to the medical student.

The artistical appearance of the work speaks the praise of those who have had the execution of it in their charge.

It affords me sincere pleasure to avail myself of this opportunity to express my heartfelt thanks to those Gentlemen who, while my Pupils, aided me in various ways in examining dif-

ferent parts of the body for the purpose of extending my observations in the science of anatomy. Among them, I am happy to speak especially of the labors of H. M. Reynolds, M. D., who labored most assiduously for upwards of two years as my assistant, principally in making *special dissections*.

To W. H. Gobrecht, M. D., late Demonstrator of Anatomy in the Medical Department of Pennsylvania College, I am under very great obligations for the able and valuable assistance he has rendered me in revising and correcting the sheets as they have passed through the press.

Although the work has been prepared more especially for the student in the dissecting-room, I feel confident that the physician will find it adapted to his wants, whenever he may wish to refresh his memory on the position and relations of any part or organ.

J. M. ALLEN.

Philadelphia, October, 1856.

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GENERAL REMARKS.

Perhaps no part of the course of study which the medical student is required to pursue is approached with a stronger feeling of reluctance than that of *practical anatomy*. Nor will the neglect of any part of his course cause him more regret when actively engaged in the duties of his profession. Although it must be admitted that there are some things connected with dissecting which are unpleasant, yet, when the value of the knowledge which can be acquired only in the dissecting-room is considered, these things should not be allowed to have the slightest influence on the conduct of the student. It is only in the dissecting-room that he can have the opportunity of seeing the various organs of the body before their relations to each other have been disturbed, or of cutting and separating the different tissues of which they are composed, and by which they are connected together. However clearly they may be presented and accurately described in the lecture-room, it is impossible that he should obtain so correct an idea of them as when he can take them in his own hands and examine them for himself.

There is, perhaps, just reason to apprehend that, for the want of having had experience in the dissecting-room, many members of our profession are deterred from making post-mortem examinations, which would be of great value to themselves, as well as to medical science. It is hardly to be expected that one who had never dissected, or who had dissected but very little, would feel himself competent to make a satisfactory examination of the internal organs of

a dead body. It may be safely averred that the student who has overcome his feeling of repugnance to dissecting, and acquired a fondness for it, will be much more likely, when he comes to practice, to avail himself of every opportunity which may offer to make a post-mortem examination than one who has not had the advantages which the dissecting-room affords.

It is scarcely necessary to say that a thorough practical knowledge of anatomy is indispensable to the successful performance of surgical operations. No student should have a desire to graduate with the intention of practising medicine without feeling assured that he was qualified to perform, at least, a large portion of all the operations which might be required within the limits of his own practice. To be obliged to send a long distance for some one to operate in a case of strangulated hernia, after having exhausted all the means in his own power to reduce it, might be the indirect cause of the death of his patient, sphacelus of the bowel having taken place in consequence of delaying the operation. But it is not to be inferred that the knowledge of anatomy to be acquired in the dissecting-room is more essential to the practice of surgery than to the practice of medicine. Medical anatomy is in every respect as important as surgical anatomy.

In regard to the time when a student should commence his dissections, I have no hesitation in saying that the *sooner* he does it after commencing the study of medicine, the better it will be for him. The time which he spends in reading on anatomy before he has had an opportunity of seeing the parts described is, in a great measure, lost. This, I believe, accords with the experience of nine out of every ten who have pursued this course. The quickest and easiest way to acquire a knowledge of a thing is to see it and handle it. A student will acquire a better knowledge of the abdominal viscera in examining them two hours in the dissecting-room than he could in reading a description of them for a week. And it is hardly necessary to say that names are learned with much greater facility when the things which they designate can be seen and inspected. This is especially true in anatomy, in which so many things are named from their appearance, location, function, &c.

The two great objects to be attained in the study of practical anatomy are—first, to learn to dissect; and second, to

learn the parts dissected. The first is to be accomplished only by care and practice. Dissecting is not merely cutting. The parts must be exposed in a dissection clearly and without mutilation. When the student first begins to dissect, it is generally on some muscle. He should proceed with this just as *slowly* as shall be necessary to remove all the fascia which covers it, so as to leave the fibres of the muscle *clear* and *distinct*. If he commences on the abdomen, he should spend at least two hours or more in removing the skin and fascia from the external oblique muscle. The fascia, which may be raised with the skin in his first dissection, should be made tense by holding it with the forceps, or with the fingers, whenever it can be done, and the knife carried in the direction of the fibres of the muscles. No fascia should be left behind in the progress of the dissection to obscure the fibres, or to be removed afterwards in detached portions. If he learns to dissect the *first* muscle right, he will have no difficulty afterwards in dissecting muscles in a manner satisfactory to himself and to his teacher. He should always see that the subject, or part, is placed in a position that will render the fibres of the muscle which he is dissecting *tense*. When this cannot be effected by position, hooks may be used for the purpose.

When a part has been dissected, it should never be abandoned until it has been so thoroughly *studied* and *learned* that the student can give an accurate description of it in his own words. It is better that he should not commit to memory the language used in the text-books which he reads, except such words as have a technical meaning. When the student has become familiar with the appearance and relations of parts, his attention should be directed to the practical application of this knowledge. If he has, for instance, examined the liver *in situ*, and its relations to contiguous parts, he should then study what would be the effect upon these parts when it had increased to two or three times its natural size; or, if an abscess should be formed in it, the different ways in which the pus might find an outlet. There is no place where he can so well appreciate these things as in the dissecting-room, with the subject before him.

As a subject is usually divided between several gentlemen, it is exceedingly desirable that each one should prosecute the dissection of the part assigned to him so as not to prevent

the others from proceeding when they may wish to change its position, or remove the part which they are dissecting. Nor should the dissection of a part, when once commenced, be delayed longer than is absolutely necessary, as it is liable to undergo decomposition, to become mouldy, or so dry and hard that it cannot be properly dissected. No part which is not required to be preserved for study, or for protecting other parts, should be allowed to remain attached to the subject, or to lie on the table after it has been cut off. Nothing contributes more to the comfort of a student, when dissecting, than to have a *clean* table; hence he should be particular to see that scraps or fluids do not collect on the table or fall on the floor around it. It is not necessary, perhaps, even to allude to the importance of *personal* cleanliness in the dissecting-room. Every student should be provided with a gown, or a change of garments, so as to prevent his clothes being soiled.

To be able to dissect properly and satisfactorily, it is indispensably necessary to have good instruments. Whether they *cost* a little more or a little less should have no influence on the mind of the student when making a purchase, provided they are *good.* I have repeatedly known students to become disgusted with dissecting for no other reason than their attempting it with poor instruments. But, however good they may be, they will become dull in using them, and require to be sharpened. This should be done as often as may be found necessary, as it is impossible to make a good dissection with a dull instrument.

It should be recollected that the dissecting-room is a place appropriated to *study* as well as to dissecting, and that consequently it is desirable that *quietness* should be observed by those who are engaged in it. The importance of this must be apparent to every one who has had any experience in the dissecting-room.

PART I.

DISSECTION OF THE HEAD AND NECK.

CHAPTER I.

OF THE HEAD.

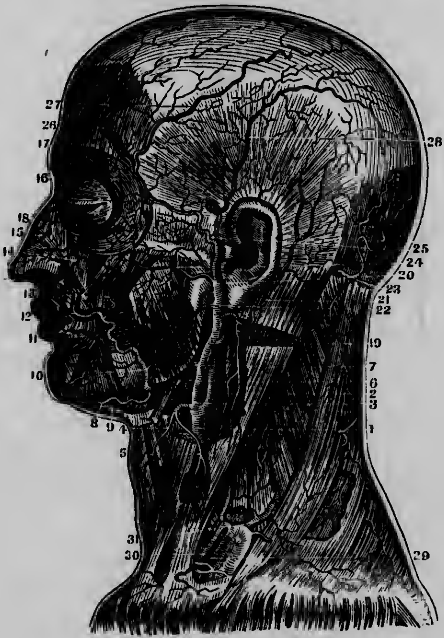
Sect. I.—Of the Face.

The Face is bounded above by the root of the nose, eyebrows, and the zygomata; laterally, by the ears and mastoid processes; below, by the base of the lower jaw, and a line drawn from its angle to the apex of the mastoid process on each side. As the face is symmetrical, it will be sufficient to describe one side. The student, however, may attend more especially to the dissection of the muscles on one side, and to the vessels and nerves on the other. It is convenient to consider the face as divided into several regions; as the Parotid, the Masseteric, the Buccal, the Mental, the Labial, the Nasal, the Orbital, and the Malar. The location of each of these divisions is indicated by its name. It is not necessary for our present purpose to define their boundaries.

To dissect the face, the head must be placed in a suitable position, and changed from time to time, as may be found most convenient. The lips and cheeks should be made tense by inserting beneath them tow or cotton, and then stitching the lips together; the nose and eyelids should also be made tense in the same manner. The integument should be raised from below upwards, and from behind forwards. For this purpose make an incision, commencing at the symphysis of the chin, along the base of the lower jaw to its angle, and thence to the apex of the mastoid process, and from this point extend it upwards in front of the ear to the zygoma, and across above the eyebrow to the root of the nose; make another incision in the median line from the symphysis of the

chin to the termination of the first at the root of the nose. These incisions may be commenced and extended, or other incisions may be made, as shall be required in the process of dissection. As a general rule, no more of the integument should be raised than is necessary to expose the parts to be examined at the time of the dissection.

Fig. 1.



A View of the External Carotid Artery and its Branches.—1. Left primitive carotid artery, seen through a section of the sterno-cleido-mastoid muscle. 2. Internal carotid artery. 3. External carotid artery. 4. Superior thyroid artery. 5. A branch to the sterno-cleido mastoideus muscle. 6. Lingual artery. 7. Origin of the facial artery. 8. Sub-mental branch. 9. Branch to the sub-maxillary gland. 10. Facial artery passing over the jaw. 11. Inferior coronary artery. 12. Superior coronary. 13. Branch to anastomose with the infra-orbital. 14. Branch to the ala nasi. 15. Anastomosis of facial with ophthalmic. 16. Nasal branch of ophthalmic. 17. Its frontal branch. 18. Branch to the orbicularis palpebrarum muscle. 19. Origin of the occipital artery. 20. Point where it passes under the splenius muscle. 21. Posterior auricular artery. 22. Origin of the internal maxillary. 23. Temporal artery. 24. Transverse facial. 25. Point of division of the temporal artery. 26. Anterior temporal artery. 27. Middle temporal artery. 28. Posterior temporal artery. 29. Internal mammary artery. 30. Inferior thyroid artery. 31. Transversalis cervicis artery.

The PAROTID and MASSETERIC regions should be examined first, and at the same time.

Fig. 2.

A VIEW OF THE VEINS OF THE HEAD AND NECK.—*a*. Facial vein. *b*. Temporal vein. *c*. Transverse facial vein. *d*. Posterior auricular vein. *e*. Internal maxillary vein. *f*. External jugular vein. *g*. Posterior external jugular. *h*. Anterior jugular. *i*. Supra-scapular and posterior scapular. *k*. Internal jugular. *l*. Occipital vein. *m*. Subclavian vein.

As the integument is raised and reflected forwards, the PLATYSMA MYOIDES, Fig. 61 (14), will be found traversing the anterior part of these regions. Its fibres are generally pale, and are situated immediately beneath the skin, in which they terminate. Some fasciculi are directed towards the angle of the mouth; they form the *risorius*, or laughing muscle, of Santorini.

The PAROTID FASCIA is quite thick and dense, forms a sheath for the parotid gland, and sends numerous prolongations into it. It is continuous below with the cervical, and in front with the masseteric fascia. The density of this fascia renders inflammation of the parotid gland painful, and retards the approach of pus, when formed in the gland, to the external surface.

The MASSETERIC FASCIA is much thinner than the parotid. Anteriorly, it is lost in the subcutaneous cellular tissue, and below, in the cervical fascia. When pus is formed beneath this fascia, it has a tendency to pass into the neck.

There are no vessels of any importance situated between the parotid gland and the skin. Some filaments of the *auricularis magnus nerve* may be traced upwards between the skin and the gland.

The borders of the parotid, as now seen, should be loosened up, and their relations carefully observed.

1. The UPPER border is situated just below the zygoma. The temporal artery, and branches of the facial and fifth pair of nerves, Fig. 62 (3), emerge from beneath this border to ascend to the side of the cranium; the temporal vein, Fig. 2, enters the gland at this point.

2. The ANTERIOR border extends from the zygoma to the angle of the lower jaw; it overlaps the masseter, more above than below. Coming from beneath this border will be found the following:—

The TRANSVERSE FACIAL ARTERY is situated about a fourth of an inch below the zygoma. It arises in the substance of the gland, from the temporal or external carotid, and crossing the upper part of the masseter, is distributed to the orbital and buccal regions.

The DUCT OF STENO, Fig. 3 (2), will be observed just below the artery. It is about the size of a crowquill, and is formed by radicals proceeding from the lobules of the gland. It is about two inches in length, and in direction corresponds very nearly to a line drawn from the meatus of the ear to the centre of the upper lip. Its buccal orifice, which is very small, is opposite to the upper middle molar tooth, and near the centre of the line indicating its direction. It perforates the buccinator muscle at the anterior border of the masseter. The position of this duct should be noticed particularly, on account of its liability to be injured from accidents, and in surgical operations.

The GLANDULA SOCIA PAROTIDIS consists of a few lobules situated between the zygoma and the parotid duct, with which it communicates by a small duct of its own. It is sometimes wanting.

The nerves, Fig. 63, consist of the Malar, Buccal, and Maxillary branches of the facial.

Fig. 3.

A View of the Salivary Glands in situ.—1. The parotid gland in situ, and extending from the zygoma above to the angle of the jaw below. 2. The duct of Steno. 3. The submaxillary gland. 4. Its duct. 5. Sublingual gland.

The Malar Branches pass upwards and forwards to ramify principally in the orbicularis palpebrarum and corrugator supercilii muscles, and the eyelids. The filaments which ascend above the orbit form anastomotic connections with the supra-orbital of the fifth pair.

The Buccal Branches cross the masseter muscle close to the duct of Steno. They divide into deep and superficial branches. The *superficial* can be traced beneath the skin to the upper lip, the nose, and the lower eyelid. They supply filaments to the orbicularis oris, the zygomatici major and minor, the levator labii superioris, and the pyramidalis nasi. The *deep* branches send filaments mostly to the remaining muscles, and form a plexus, as well as interlace and anastomose with the infra-orbital of the fifth pair. They also anastomose with the internal and external nasal branches of the ophthalmic nerve.

The Maxillary Branches pass over the lower part of the masseter, and proceed forwards to the chin. They give filaments to the masseter, the buccinator, the depressor

anguli oris, depressor labii inferioris, levator labii inferioris, and the platysma myoides. They anastomose and interlace with the mental branches of the inferior dental nerve, forming the mental plexus. They also anastomose with the buccal branch of the inferior maxillary nerve. The muscles of the face are supplied principally by the facial, while the skin and mucous membrane derive their supply mainly from the fifth.

3. The LOWER border of the parotid projects somewhat into the neck, and rests against the posterior belly of the digastricus, the stylo-hyoideus, and that reflection of the cervical fascia which is attached to the stylo-maxillary ligament, and forms a septum between the parotid and submaxillary regions. Near the angle of the jaw the cervical branches of the facial nerve escape from the gland, to be distributed in the upper part of the neck, while branches of the auricularis magnus, a branch of the cervical plexus, enter it. The temporo-maxillary vein will also be found here, leaving the gland to form the external jugular. The external carotid artery enters it on a plane deeper than the digastric and stylo-hyoid muscles, to divide into the temporal and internal maxillary branches. The internal carotid artery and the internal jugular vein with the eighth and ninth pairs of nerves, are situated behind the gland.

4. The POSTERIOR border rests against the auditory process and concha of the ear above, and the mastoid process and sterno-cleido-mastoid muscle below. The posterior auricular artery and nerve emerge from beneath this border of the gland to get behind the ear.

The gland must now be dissected so as to get a view of the vessels and nerves in its substance.

The main trunk of the facial nerve may be easily found by tracing into the substance of the gland one or more of its branches which have already been described. It enters the gland shortly after leaving the foramen stylo-mastoideum, and, after passing upwards and forwards over the external carotid, divides into two principal branches, the Temporo-maxillary and the Cervico-maxillary. The former subdivides into the *temporal*, *malar*, and *buccal;* the latter into the *maxillary* and *cervical*, Fig. 63.

The TEMPORO-MAXILLARY division is connected by one or more branches with the temporo-auricular branch of the fifth pair. This last branch passes through the upper part of

the gland, and is deeper seated than the facial. The facial gives off the following small branches before it enters the gland:—

The *posterior auricular*, which sends filaments to the posterior and superior muscles of the ear, and to the posterior belly of the occipito-frontalis; the *styloid*, which is distributed to the stylo-hyoid muscle; and the *digastric*, which goes to the digastric muscle, and also anastomoses with the glosso-pharyngeal and pneumogastric nerves. The auricularis magnus penetrates the parotid, in which some of its filaments anastomose with the facial, while others pass through it to the cheek, and to the skin behind the ear.

The external carotid artery enters the gland from below, and divides into the internal maxillary and temporal; it also gives off branches to the gland and to the integument and masseter in front. The veins in the gland correspond to the arteries.

The gland may now be entirely removed, preserving the branches of the facial nerve so that they may be traced to their destination, and its relations to the deeper seated parts observed. It will be found to fill up several irregularities, and to be in relation with the temporo-maxillary articulation, the glenoid cavity behind the glaserian fissure, the ramus of the inferior maxilla, the styloid and mastoid processes of the temporal bone, the internal pterygoid and stylo-glossus muscles. The internal carotid artery generally occupies a sulcus on its internal surface. The removal of this gland is rendered difficult from its deep-seated projections. It can be torn out from the depressions which it occupies, when it could not well be dissected out.

The *masseter* muscle will be described in connection with the spheno-maxillary region; and the vessels and nerves behind the parotid with the deep-seated parts of the neck.

The Buccal, Mental, Labial, and Nasal Regions may now be dissected and examined together. The principal constituents of these regions are the Muscles, Arteries, and Nerves. The Muscles are mostly subcutaneous, and belong to the nose and mouth. The principal Artery is the facial, with its branches. Besides this, small branches are furnished by the temporal, internal maxillary, and ophthalmic. The facial vein is situated on the outside of the facial artery, with which it corresponds in its direction and branches. The nerves are derived from the fifth, and facial or portio dura,

Fig. 63 (1), of the seventh pair. The branches of the facial have been noticed in the description of the Parotid and Masseteric regions. Those of the fifth pair are the terminal branches of the inferior dental, the buccal, the infra-orbital, and the nasal. The inferior *dental* comes through the mental foramen, which is situated just below the second bicuspid tooth; the *buccal* enters the buccal region behind the anterior border of the masseter; the *infra-orbital* emerges from the infra-orbital foramen in the upper part of the canine fossa; the *nasal* comes from the inner canthus of the eye, and from the junction of the lower end of the nasal bone with the cartilage.

To dissect these parts, the skin must be reflected forwards to the median line, and upwards as far as the root of the nose and the attached border of the lower eyelid.

The Platysma Myoides is lost in the lower part of the face. The posterior fasciculi which cover the facial artery and the lower portions of the parotid gland and masseter muscle, terminate in the subcutaneous areolar tissue and a fasciculus which turns forwards towards the angle of the mouth, called by Santorini the *risorius novus*. The middle fasciculi blend with the depressor anguli oris and depressor labii inferioris muscles. The anterior fibres mix with those of the opposite side.

The superficial fascia may now be removed in detached portions while exposing the muscles, arteries, and nerves.

The facial artery, Fig. 1 (10), is subcutaneous throughout its whole course, except where it passes beneath the zygomatici major and minor muscles, and can be easily traced. Its branches, consisting of the masseteric, mental, inferior and superior coronary and nasal, are irregular in their origin, and must be looked for as the main trunk is dissected from below upwards. The position of the facial artery where it rests upon the inferior maxilla should be noticed, as pressure applied to it at this point will arrest hemorrhage from it or any of its branches.

The Orbicularis Oris, Fig. 61 (13), is situated in the lips, the principal part of which it forms. It consists of two fasciculi, one for each lip. These blend at the angles of the mouth with the buccinators, and other muscles inserted at these points. To dissect this muscle, the lips must be made tense. Its external surface is mixed, more or less, with fat,

and adheres closely to the skin. The labial glands are placed between its inner surface and the mucous membrane. Its action is to close the mouth, and antagonize the muscles inserted into the lips.

The Depressor Anguli Oris, or Triangularis, Fig. 61, *arises* from a ridge on the outer surface of the inferior maxilla, between the insertion of the masseter and the mental foramen. The fibres converge, pass upwards, and are *inserted* into the angle of the mouth. It partly overlaps the depressor labii inferioris and buccinator muscles, from which it is readily distinguished by the different direction of their fibres. It depresses the angle of the mouth, as its name indicates.

The Depressor Labii Inferioris, or Quadratus Menti, Fig. 64 (10), *arises* from the base of the inferior maxilla, commencing near the symphysis of the chin, and extending outwards a short distance beneath the preceding muscle. Its fibres pass upwards and inwards, and are *inserted* into the orbicularis and skin of the lower lip. It is difficult to make a clean dissection of this muscle, on account of the adipose substance mixed with its fibres. The terminal branches of the *inferior dental artery* and *nerve* emerge from the mental foramen under this muscle. By detaching a small portion of the muscle from its origin below the second bicuspid, and raising it up, the foramen will be found and the nerve escaping from it. From this point its branches can be easily traced upwards to the skin and mucous membrane of the lip, and upwards and outwards where they interlace with the facial nerve, to form the *mental plexus*. This nerve is sensor, and supplies, besides the lips, the lower and inner part of the face generally.

The Levator Labii Inferioris, or Levator Menti, Fig. 64 (11), is situated between the mucous membrane and the last muscle. It *arises* from the alveolar process opposite the incisor teeth; its fibres radiate as they pass downwards and forwards, and are *inserted* into the integument of the chin. The lower part of it is blended with fat. To expose it, the lip should be everted, and the mucous membrane dissected away. It elevates the lower lip by drawing up the chin.

The Buccinator, Fig. 64 (8), is a broad, thin muscle, located in the cheek. It has three origins; the *lower* one *arises* from

4

the external surface of the alveolar process of the inferior maxilla in front of the coronoid process; the *upper* one from the alveolar process of the superior maxilla, in front of the pterygoid process; and the *middle* one from the pterygo-maxillary ligament, which stretches from the pterygoid to the base of the coronoid process, and to which the superior constrictor muscle of the pharynx is also attached. From these different origins its fibres converge and pass forwards to the angle of the mouth to be *inserted*, the inferior ones into the upper, and the superior ones into the lower lip. This muscle is separated behind from the ramus of the inferior maxilla and masseter, by a mass of fat, also by two of the buccal glands called *molar*. It is perforated by the duct of Steno. It is crossed transversely by the buccal branches of the facial and fifth pair of nerves. The facial artery and vein pass over it vertically. The buccal glands separate its internal surface from the mucous membrane. It draws the angle of the mouth backwards, and makes the lips tense; assists in expelling the contents of the mouth, and antagonizes the tongue in keeping the food in the process of mastication between the teeth.

The Zygomaticus Major, Fig. 61 (13), *arises* from the malar bone, just above its lower border, passes downwards and inwards, and is *inserted* into the angle of the mouth. It is generally surrounded by more or less fat, and its upper part is covered by the orbicularis palpebrarum; it crosses over the facial artery and vein. Its action is to draw the angle of the mouth upwards and backwards, as in smiling.

The Zygomaticus Minor, Fig. 61 (12), is often a fasciculus from the orbicularis palpebrarum. When a distinct muscle, it *arises* from the malar bone, above the last muscle, and is *inserted* into the upper lip with the levator labii superioris, with which it acts, at the same time drawing the lip outwards.

The Levator Labii Superioris, Fig. 61 (8), *arises* from the anterior border of the floor of the orbit, above the canine fossa, where it is overlapped by the orbicularis palpebrarum. Its fibres converge as they pass downwards to be *inserted* into the skin of the upper lip, and the orbicularis oris. All the lower part of this muscle is subcutaneous. Its action is indicated by its name.

The *infra-orbital nerve* and *artery* will be found escaping from the infra-orbital foramen, beneath the upper part of this

muscle. To expose these, cut down through the muscle in the direction of its fibres, upon the foramen, and gently raise the nerve, when its filaments will be seen to radiate upwards to the lower eyelid, inwards to the nose, downwards to the upper lip, and outwards and downwards to the cheek. They intermix and anastomose with the facial to form the *infra-orbital plexus.* It requires a good deal of care and patience to trace these filaments to their termination. The infra-orbital artery is one of the terminal branches of the internal maxillary. It inosculates with the facial, transverse facial, and ophthalmic.

The Levator Anguli oris, or Caninus, Fig. 64 (6), *arises* from the canine fossa, below the infra-orbital foramen, and beneath the preceding muscle; passes downwards, and is *inserted* into the angle of the mouth. It raises the angle of the mouth, and antagonizes the depressor anguli oris, with which some of its fibres are continuous.

The Levator Labii Superioris Alæque Nasi, Fig. 61 (8), *arises* from the upper part of the nasal process of the superior maxilla. It passes downwards on the side of the nose, divides into the nasal and labial portions, and is *inserted*, the former into the ala of the nose, and the latter into the upper lip. Its name indicates its use.

The Compressor Nasi, or Triangularis Nasi, Fig. 64 (5), is partly concealed by the preceding muscle. It *arises* from the inner part of the canine fossa, passes forwards to spread out over the ala of the nose, and is *inserted* into a thin aponeurosis, common to it and its fellow on the opposite side; it is also connected with the pyramidalis. It compresses the nostril when it acts alone, but may expand it when it acts in conjunction with the pyramidalis.

The Depressor Labii Superioris Alæque Nasi, or Myrtiformis, Fig. 64 (7), is exposed by everting the upper lip, and dissecting off the mucous membrane on the side of the frænum. It *arises* from the alveolar process of the superior maxilla in front of the incisor teeth, passes upwards and forwards, and is *inserted* into the upper lip and the fibro-cartilage of the ala and septum of the nose. Its name indicates its actions.

The Pyramidalis Nasi, Fig. 64 (3), appears to be a fasciculus of the occipito-frontalis prolonged downwards on the nose.

It is *inserted* into the aponeurosis of the compressor nasi. It causes the vertical ridge sometimes seen at the root of the nose. The integument of the nose is supplied with nerves from the infra-orbital and the internal and external nasal. The facial artery, after giving off the branches already enumerated, ascends to the forehead between the eyebrows; its terminal branch is called the *angularis*.

SECT. II.—APPENDAGES OF THE EYE OUTSIDE OF THE ORBIT.

The dissection of the orbital region will embrace those appendages of the eye which can be exposed and studied without removing any portion of the walls of the orbit. These consist of the orbicularis palpebrarum, corrugator supercilii, and tensor tarsi muscles; the eyebrows, eyelashes, tarsal cartilages, Meibomian glands, conjunctiva, caruncula lachrymalis, lachrymal gland and ducts, puncta lachrymalia, lachrymal canals and sac, and nasal duct.

The integument in this region should be removed by cutting in the direction of the fibres of the orbicularis, but in the first place the eyelids should be made tense by inserting beneath them cotton or tow, and then stitching their edges together.

The EYEBROW, Fig. 4 (1), on each side, is situated just above the attached border of the upper eyelid, and rests on the superciliary ridge of the frontal bone. It is generally arched and covered with hairs, which have a direction from within outwards. The integument is separated from the orbicularis and occipito-frontalis muscles by a thick, dense cellulo-adipose layer. The eyebrows can be moved upwards, downwards, or towards each other.

Fig. 4.

A FRONT VIEW OF THE LEFT EYE, MODERATELY OPENED.—1 The supercilia. 2. The cilia of each eyelid. 3. The inferior palpebra. 4. The internal canthus. 5. The external canthus. 6. The caruncula lachrymalis. 7. The plica semilunaris. 8. The eyeball. 9. The pupil.

The EYELASHES, Fig. 4 (2), consist of three or four rows of curved hairs, growing from the free borders of

the eyelids. In the upper eyelid they are curved upwards, in the lower, downwards; they are longer in the centre than at the extremities of the eyelids. Their bulbs are situated between the orbicularis and the tarsal cartilages.

The ORBICULARIS PALPEBRARUM, Fig. 61 (7), entirely surrounds the fissure between the eyelids. It is divided into three portions, viz: the orbicular, the palpebral, and the ciliary. The *orbicular* is spread out around the base of the orbit, and rests, above, on the superciliary ridge and corrugator supercilii muscle; on the outside, on the temporal aponeurosis, and below, on the malar bone and zygomaticus major and levator labii superioris muscles; its fibres are red and well marked. The *palpebral* and *ciliary* portions consist of a thin layer of pale fibres situated in the eyelids; the latter lies next to their free borders, and is somewhat thicker than the former. This muscle *arises* from the internal angular process of the frontal bone, the nasal process of the superior maxilla, and from the upper and lower border of the *tendo-palpebrarum;* from this narrow attachment the fibres proceed outwards, so as to embrace the base of the orbit and the fissure between the eyelids. It closes the eyelids, as in winking, principally by depressing the upper one; this is done by the palpebral and ciliary fibres, which are involuntary in their action. It also presses the eyelids against the ball of the eye, and directs the tears towards the puncta lachrymalia. As its principal attachment is at the inner canthus of the eye, it draws the integument in that direction, and that above the orbit more than that below. It is separated in the eyelids from the skin by loose areolar tissue, which is very liable to serous infiltration.

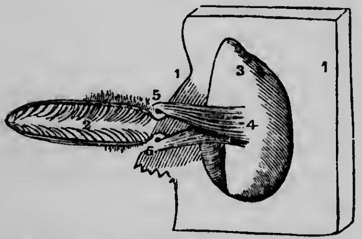
The TENDO-PALPEBRARUM, or LIGAMENTUM PALPEBRARUM, arises from the nasal process of the superior maxilla in front of the lachrymal groove, passes outwards and backwards to the inner angle of the eyelids, where it divides into two parts, one to be attached to the upper, and the other to the lower tarsal cartilage. It is about two lines and a half in length, and crosses the lachrymal sac a little above its centre; its broadest diameter is at first vertical and then horizontal; from its upper and lower borders a fibrous lamina is reflected over the lachrymal sac, and is attached to the osseous margin which surrounds it. When the orbicularis

contracts, this tendon can be felt in the living subject. In opening the lachrymal sac, the incision should be made below the tendon, to avoid injuring it.

The CORRUGATOR SUPERCILII, Fig. 64 (2), is exposed by reflecting downwards the upper portion of the orbicularis. It *arises* from the inner part of the superciliary ridge, passes upwards and outwards, and is *inserted* into the orbicularis, near the junction of its middle and outer thirds. The supercilii muscles depress and approximate the eyebrows, producing the vertical wrinkles on the forehead. The expression of frowning depends on the action of these muscles.

The TENSOR TARSI, or THE MUSCLE OF HORNER, Fig. 5, *arises* from the upper part of the os unguis just behind the lachrymal groove; it is about three lines in breadth and six in length, and is situated behind the tendo-palpebrarum. It divides into two slips, which are *inserted*, one into the upper lachrymal duct, and the other into the lower. To expose this muscle the eyelids should be detached, except at the inner canthus, and reflected over the nose; its fibres will then be distinctly seen by the removal of a portion of the conjunctiva and areolar tissue between the eyeball and the lachrymal bone. Its action is to govern the position of the puncta lachrymalia, so as to facilitate the entrance of the tears, and to keep the eyelids applied to the eyeball; it may also compress the lachrymal sac if distended.[1]

Fig. 5.



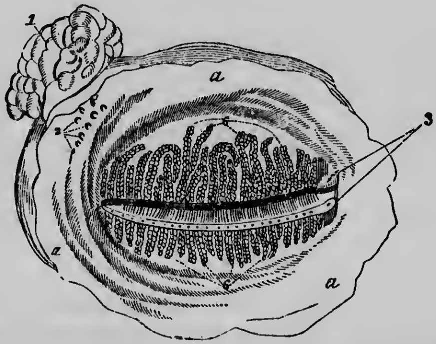
A VIEW OF THE TENSOR TARSI MUSCLE.—1, 1. Bony margins of the orbit. 2. Opening between the eyelids. 3. Internal face of the orbit. 4. Origin of the tensor tarsi. 5, 5. Insertion in the neighborhood of the puncta lachrymalis.

The MEIBOMIAN GLANDS, Fig. 6 (6), consist of a series of tubes, more or less tortuous, situated in grooves on the posterior surface of the tarsal cartilages. In length they cor-

[1] A small muscle, situated in the outer part of the orbit, and connected to the tarsal cartilages, is described by Dr. N. R. Mosely, of Philadelphia, in the *Boston Medical and Surgical Journal*, August 3, 1853. Dr. Mosely regards it as an antagonistic muscle of the tensor tarsi of Horner.

respond to the breadth of the cartilages. There are between thirty and forty in the upper lid, and about twenty in the lower. Each tube has opening into it on each side several small pouches or follicles. Their external orifices may be seen on the posterior edge of the free border of each lid, and from which a waxy secretion may be pressed; this secretion prevents the tears from flowing over the lids.

Fig. 6.



MEIBOMIAN GLANDS, SEEN FROM THE INNER OR OCULAR SURFACE OF THE EYELIDS, WITH THE LACHRYMAL GLAND—THE LEFT SIDE. *a.* Palpebral conjunctiva. 1. Lachrymal gland. 2. Openings of lachrymal ducts. 3. Lachrymal puncta. 6. Meibomian glands.

The TARSAL CARTILAGES, with their fibrous attachments, form the framework of the eyelids. They consist of two fibro-cartilaginous plates, one for each lid. Each one presents two surfaces and two borders. The external surface of each is convex, and separated from the ciliary fibres of the orbicularis palpebrarum by a thin layer of areolar tissue; the internal surface is concave, and grooved for the Meibomian glands, and separated from the conjunctiva by areolar tissue also. The free borders are thick, and form the free edges of the eyelids; they are nearly horizontal when the lids are closed, and slightly beveled from before backwards, so as to form, when they are in apposition, a canal for the passage of the tears from the outer to the inner part of the eyeball. The lower one is merely a narrow band, about a line and a half in breadth. The upper one is nearly half an inch broad at its centre, but diminishes in breadth towards

its extremities. Each one is attached to the margin of the orbit by a *fibrous lamina*, which is continuous with the periosteum. This fibrous layer, sometimes called *the palpebral* or *broad tarsal ligament*, is thin at the inner part of the orbit, but quite thick and dense at the outer part. Besides the fibrous layer from the margin of the orbit, the tarsal cartilage of the upper lid has inserted into it the tendon of the levator palpebræ superioris muscle. The internal extremities of the tarsal cartilages are fixed by the tendo-palpebrarum.

The Caruncula Lachrymalis, Fig. 4 (6), is a small red body situated at the inner angle of the eyelids, and in the centre of the *lacus lachrymalis.* It is composed of sebaceous follicles resembling the Meibomian glands. It secretes a whitish substance, which is often seen at the inner canthus. It is covered by a fold of the conjunctiva, which is perforated by the external orifices of the follicles; several hairs usually project from it. It varies in color, as in health and in sickness.

The Conjunctiva is divided into an *ocular* and a *palpebral* portion. The former covers the anterior third of the eyeball, with which it is loosely connected around its circumference, but becomes more closely adherent as it approaches the margin of the cornea. That it extends over the cornea can be very satisfactorily demonstrated. It is, however, so modified in its structure as to become perfectly transparent, and so intimately blended with the cornea, that it cannot be easily dissected off, especially from the centre of it. The latter, or palpebral portion, lines the internal surfaces of the lids, and is continuous over their free margins with the skin. It is closely connected to the posterior surfaces of the tarsal cartilages, where it covers the Meibomian glands, and is very vascular.

The *palpebral sinuses* are formed by the reflection of the conjunctiva from the globe of the eye to the lids. In these sinuses, or *culs-de-sac*, it is very loosely connected to the areolar tissue beneath. At the inner canthus the conjunctiva forms a fold, called the *plica semilunaris.* This is just outside the caruncula, and disappears when the globe is turned outwards; it may be regarded as the rudiment of

the membrana nictitans or the third eyelid in birds. The conjunctiva is perforated by the lachrymal ducts in the outer part of the superior palpebral sinus; by the Meibomian glands, along the inner edge of the lids; by the sebaceous follicles in the caruncula lachrymalis; and by the puncta lachrymalia near the inner extremities of the eyelids.

The Lachrymal Gland, Fig. 6 (1), may now be exposed in the upper and outer part of the orbit. It should be studied from without and also from within the orbit. In structure it resembles the salivary glands. It consists of two lobes, an *orbital* and a *palpebral.* The former is about half an inch in breadth, and nearly three-fourths of an inch in length; its orbital surface is convex, and occupies the lachrymal fossa on the inner side of the external angular process of the frontal bone; its ocular surface is concave, and in apposition with the globe of the eye. The latter or palpebral lobe is prolonged into the upper lid as far as the attached border of the tarsal cartilage; its under surface is covered by the conjunctiva, through which it can be seen when the lid is everted. The two lobes are separated from each other merely by fascia. The tears secreted by the lachrymal gland are poured upon the conjunctiva through from six to ten ducts; these are arranged in a line, and open on the inner surface of the upper lid. They may be detected by the application of a colored liquid, which will be absorbed into their mouths.

The Puncta Lachrymalia, Fig. 6 (3), are two orifices, one in the free border of each eyelid at the inner extremity of the tarsal cartilage. They may be distinctly seen in the centre of two small eminences called the *lachrymal papillæ.* They look somewhat backwards towards the eyeball, in which position they are kept by the tensor tarsi muscle. A bristle can be readily introduced into them, and through them into the ducts which lead into the lachrymal sac.

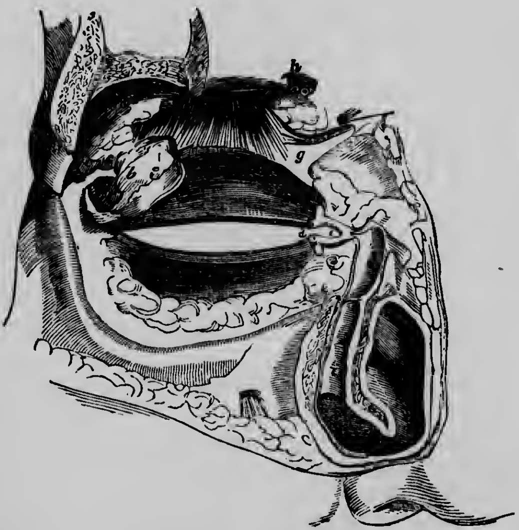
The Lachrymal Canals, or Canaliculi Lachrymales, Fig. 7, *e*, extend from the puncta to the lachrymal sac. Their parietes are of a dense fibrous structure, which keeps them constantly open for the passage of the tears. The inferior one is the shortest; it at first descends, then turns inwards and upwards to enter the upper and outer part of the sac. The superior one is at first directed upwards, then inwards

and downwards, and enters the sac near the other, behind the tendon of the orbicularis.

The LACHRYMAL SAC occupies a fossa formed by the superior maxilla and os unguis in the inner and anterior part of the orbit. It is continuous with the upper extremity of the ductus ad nasum, from which it is separated only by a constriction or fold of the mucous membrane. It is separated from the anterior extremity of the middle meatus of the nose by the lachrymal bone.

The DUCTUS AD NASUM, Fig. 7, *f*, leads from the lachrymal sac into the anterior extremity of the inferior meatus of the

Fig. 7.



LACHRYMAL APPARATUS AND NASAL DUCT.—*a, b, c.* Lachrymal gland and its appendage. *d.* Puncta lachrymalia. *e.* Lachrymal canals. *f.* Nasal duct laid open. *g.* Insertion of tendon of superior oblique muscle after being reflected. *h.* Supra-orbital foramen; the artery, vein, and nerve have been cut across. *i.* Interior of nasal duct near its termination in nostril.

nose. It is directed downwards, backwards, and outwards; its osseous walls are composed of the superior maxilla, os unguis, and inferior turbinated bone. At is lower orifice there is a fold of mucous membrane which may serve as a valve. Its length is about three-fourths of an inch. Through the

lachrymal ducts, lachrymal sac, and nasal duct, the conjunctiva is continuous with the lining membrane of the nasal fossa; and as the former is prolonged into the lachrymal gland through its excretory ducts, there is a direct sympathetic connection established between that gland and the mucous membrane of the nose.

The appendages of the eye, which have just been described, deserve the careful attention of the student. They are frequently the seat of diseases which require surgical operations. A minute examination of the structure of the eyelids, and the lachrymal passages especially, is important.

SECT. III.—DISSECTION OF THE SOFT PARTS ON THE UPPER PART OF THE CRANIUM.

This region is included within the circumference of a line commencing just above the root of the nose, and extending round the head through the eyebrows, along the zygomatic arches, and just above the ears back to the occipital protuberance. It is subdivided into the Frontal, Temporal, Auricular, and Occipital regions. The parts to be studied in this dissection are: the integuments, the cellulo-adipose layer, the temporal fascia, the occipito-frontal muscle, the upper part of the orbicularis palpebrarum, the temporal muscle above the zygomatic arch, the attollens aurem, the attrahens aurem, the retrahens aurem, the cranial branches of the occipital, temporal, auricular, supra-orbital and facial arteries, and their corresponding veins, the cranial branches of the occipital, facial, and trifacial nerves, and the pericranium.

In removing the skin, an incision should be made from the root of the nose along the median line to the occipital protuberance, and another at right angles to this, extending down to the ear. The skin should then be dissected off in two flaps. The different layers which cover the cranium should be dissected on one side, and the nerves and vessels on the other. The integument which is covered with hair adheres closely to the cellulo-adipose layer, and some care is requisite to separate them.

The CELLULO-ADIPOSE LAYER is the thickest and most dense on the upper and posterior part of the head. Numerous

adipose cells are interspersed through it. The compactness of this structure, with its high degree of vitality, is said to be the cause of the tendency of the scalp to take on erysipelatous inflammation after injuries. When arteries are divided in its substance, the forceps instead of the tenaculum should be used in ligating them.

The OCCIPITO-FRONTAL MUSCLE, Fig. 61 (1, 2, 3), with its broad aponeurosis, extends from the root of the nose and the superciliary ridge to the superior transverse ridge of the occiput. It consists of two fleshy bellies connected by a broad aponeurosis, which expands over the arch of the cranium.

The OCCIPITAL PORTION *arises* from the superior transverse ridge of the occipital bone, and from the adjacent portion of the mastoid process of the temporal bone. The fibres pass upwards and somewhat inwards, and *terminate* in the tendon.

The FRONTAL PORTION is blended with the pyramidalis nasi, the orbicularis palpebrarum, and the integument; some of its fibres are also attached to the internal angular process of the frontal bone. It joins the tendon nearly opposite the coronal suture. Its fibres are generally paler than those of the occipital portion. The tendon of this muscle is continuous across the median line with that of the opposite side; and from its outer border, the superficial temporal fascia extends downwards over the deep temporal fascia or aponeurosis. The use of this muscle is to move the scalp, to raise the eyebrows, and, in some measure, the upper eyelids. It adheres closely to the scalp, while it glides freely on the parts beneath it. It causes the transverse wrinkles on the forehead.

The ATTOLLENS AUREM, Fig. 61 (4), is situated in the temporal region above the ear. It *arises* broad from the aponeurosis of the occipito-frontal muscle; its fibres converge as they descend, and are *inserted* into the concha of the ear. Its use is to raise the ear, and to render tense the aponeurosis from which it arises.

The ATTRAHENS AUREM, Fig. 61 (3), is situated immediately in front of the preceding muscle. It *arises* from the aponeurosis of the occipito-frontal muscle and the zygoma, and is *inserted* into the anterior part of the helix. It draws the ear upwards and forwards.

The RETRAHENS AUREM, Fig. 61 (6), is placed behind the ear. It generally consists of two or three fasciculi. It *arises* from the mastoid process, and is *inserted* into the posterior and lower part of the concha. It draws the ear backwards and enlarges the meatus. Having dissected the occipito-frontal muscle and the muscles of the ear, they should be removed. Beneath the occipito-frontal muscle, more or less loose areolar tissue will be observed, which facilitates the movements of that muscle on the pericranium. The *pericranium* is the external periosteum of the bones which it covers. It can be readily separated from the bone except along the sutures.

The student should now carefully study the different layers which have just been examined with reference to wounds involving one or more of them, and especially in view of collections of pus between the different layers, or beneath the pericranium.

The TEMPORAL APONEUROSIS occupies the whole of the temporal region. It *arises* from the temporal ridge above, and is *attached* below to the zygomatic arch. The lower part of it is divided into two layers, one of which is inserted into the outer, and the other into the inner border of the arch, thus leaving a triangular space between them, which is filled with adipose substance, and traversed by the middle temporal artery, and a small branch of the superior maxillary nerve. The temporal muscle arises partly from the under surface of this aponeurosis. It will be observed, that if pus should collect beneath the temporal aponeurosis, it would naturally seek an outlet beneath the zygomatic arch; or, if it should collect between the two layers above the zygoma, it would necessarily be confined to that space.

The TEMPORAL MUSCLE, Fig. 64 (1), lies beneath the temporal aponeurosis. It *arises* from the whole of the temporal fossa and ridge, from the inner surface of the aponeurosis and from the zygomatic arch. Its fibres converge, and passing downwards beneath the zygoma, are *inserted* by a strong tendon into the coronoid process of the inferior maxilla. The muscle increases in thickness as it descends. When the entire muscle acts, it raises the lower jaw; the posterior fibres can move it backwards, while the anterior fibres can draw it forwards. This muscle may also assist in producing a rotary movement of the jaw.

It will be seen that the temporal aponeurosis and muscle, by their strength and thickness, serve greatly to protect that portion of the parietes of the cranium which they cover, and which in this region are very thin.

The vessels and nerves may now be dissected on the opposite side; and for this purpose, the integument should be raised in the same manner as for the dissection of the muscles and fasciæ.

The temporal and occipital, Fig. 1 (23, 20), are the principal arteries. Besides these, there are the terminal branches of the facial, the supra-orbital, and the posterior auricular. The nerves, Fig. 63, are derived from the fifth, the facial, and the cervical. To dissect the vessels and nerves, they should be traced from below upwards.

Entering the frontal region from below will be found the terminal branch of the facial artery, and the supra-orbital, and near these the supra-orbital and frontal nerves.

The SUPRA-ORBITAL ARTERY and NERVE pass through the supra-orbital foramen. The artery is distributed to the muscles and integument of this region. The nerve ascends beneath the orbicularis palpebrarum and occipito-frontal muscles, and some distance above the orbit divides into two cutaneous branches, which perforate the latter muscle, and ascend in long slender filaments to the top of the head. In its course it gives branches to the muscles beneath which it passes, and through which filaments are sent to the skin which covers the muscles.

The terminal branch of the FACIAL ARTERY supplies the parts above the root of the nose.

The FRONTAL NERVE is placed on the inner side of the supra-orbital, and has a similar course and distribution.

Besides the supra-orbital, the OPHTHALMIC ARTERY usually sends one or more small branches to the forehead.

The TEMPORAL ARTERY passes upwards over the zygoma, and close to the ear. It is accompanied by the auriculo-temporal branch of the inferior maxillary division of the fifth pair of nerves. It divides into an anterior and a posterior branch. Just above the zygoma it gives off the middle temporal branch, which perforates the temporal aponeurosis.

The anterior division pursues a tortuous course upwards and forwards to the upper part of the forehead. The posterior division passes upwards and backwards to the upper and back part of the head. The lower part of this artery should never be opened for the abstraction of blood, on account of its depth and the danger of ecchymosis occurring. The anterior division is superficial, and easily found on the forehead.

The NERVES in this region are a small branch of the *superior maxillary*, the *auriculo-temporal* branch of the inferior maxillary, and branches of the *facial* nerve.

The first one perforates the temporal aponeurosis just above the zygoma. The auriculo-temporal divides into branches, which ascend to the top of the head. It also sends filaments to the upper part of the ear, to the retrahens aurem, and to the integument above the ear. The branches of the facial nerve pass up over the zygoma, and ramify in the temporal and frontal regions, anastomosing with the branches of the fifth pair.

The POSTERIOR AURICULAR ARTERY, Fig. 1 (21), ascends between the mastoid process and the ear. It sends branches to the ear, to the integument behind the ear, and to the occipito-frontal muscle and the retrahens aurem. The posterior auricular branch of the facial nerve, and the deep auricular branch of the auricularis magnus, are found in this region.—The former passes upwards over the anterior and outer surface of the mastoid process, and divides into an ascending and a horizontal branch. The ascending branch supplies the retrahens aurem, and the attollens aurem; the horizontal branch is distributed to the occipito-frontal muscle. The latter ascends at first in front of the mastoid process, and then behind the retrahens aurem. It divides into an anterior and a posterior branch, which are distributed to the skin.

The OCCIPITAL ARTERY becomes superficial at the inner border of the splenius muscle. It then ascends on the back part of the head, ramifying in the scalp, and anastomosing with the posterior auricular, the temporal, and the corresponding one on the opposite side.

The NERVES in this region are the *Occipitalis Major* and the *Occipitalis Minor*. The former perforates the trapezius muscle, and accompanies the occipital artery. The latter ascends on the inner border of the mastoid muscle, and rami-

fies on the back of the head, between the auricular and the great occipital nerves.

The SUPERFICIAL VEINS, Fig. 62, of the head correspond generally to the arteries. Those which pass through the foramina in the parietal bones are named the *emissaries* of *Santorini*. They open into the superior longitudinal sinus.

SECT. IV.—DISSECTION OF THE MEMBRANES OF THE BRAIN.

Having dissected the soft parts covering the upper part of the cranium, the calvaria may be removed. If it be desired to preserve the cranium for a preparation, this should be done with a saw. The incision should pass through the occipital protuberance behind, about half an inch above the ear on each side, and just above the superciliary ridges in front. The variations in the thickness of the skull at different points through which this incision would pass, should be observed on one which has already been sawed. It is better to divide both tables entirely with the saw, so that but little effort will be required afterwards to raise the calvaria from the dura mater. This may be done with a chisel, first prying up one part and then another, until it has been detached around the whole circumference of the incision. If the saw be sharp, there will be but little danger of injuring the brain or its membranes, as there will then be no necessity for using any force to press it down on the bone. The position of the subject should be changed to saw through the anterior and posterior portions of the cranium.

The strength of the adhesions between the upper part of the cranium and the dura mater, varies greatly in different subjects. Sometimes a good deal of force is required to effect a separation, although the bone has been entirely divided.

The description of the meninges of the brain will be divided into two parts. The first will embrace all the parts which can be examined before the removal of the brain; the second will include the deep parts, or those which can be seen only after the brain has been removed.

The membranes of the brain consist of the Dura Mater, the Arachnoid, and the Pia Mater.

The DURA MATER is a *fibro-serous* membrane. It adheres to the inner surface of the osseous walls of the cranium. It is of a dense fibrous structure. Its fibres run in different directions, thus imparting to it great strength. In some places it separates into two layers, as in the formation of sinuses for the transmission of venous blood. The firmness of its attachment at different points to the cranium, prevents any general displacement of it taking place. Its external surface is rough, while its internal surface is smooth, and presents the appearance of serous membranes generally. Its uses are the following:—

1. It performs the office of an internal periosteum to the bones of the cranium. 2. It furnishes processes to separate and support different parts of the encephalon. 3. It supplies canals or sinuses for conveying venous blood. 4. It provides the nerves with fibrous sheaths as they pass through the foramina in the base of the cranium. 5. It affords a general protection to the brain, especially in early life, before the bones of the cranium are yet completely ossified. Its intimate connection with the external periosteum will be noticed at another time.

The ARACHNOID TUNIC is a *serous* membrane, and, like other serous membranes, forms a shut sac; the reflected portion of it, however, is described as a part of the dura mater. This membrane, the visceral portion, surrounds every part of the encephalon. It adheres quite closely to the pia mater, especially immediately over the convolutions, except at particular parts on the under surface of the brain. It is connected to the reflected portion by an arrangement consisting of tubes which allows the vessels and nerves to pass to and from the brain without interrupting its continuity. The ends of each one of these tubes are continuous, the one with the reflected portion, and the other with the visceral portion.

The PIA MATER is a *vascular* membrane. It invests every part of the exterior of the encephalon, dips in between the convolutions, and also lines the ventricles. It is intimately connected with the substance of the brain by vessels and prolongations of areolar tissue.

With these general remarks on the meninges of the brain, the student will be prepared to commence the examination

of them *in sitû*, and as they will appear from time to time in the progress of his dissection.

On the inner surface of the calvaria will be observed a *groove* extending along the median line; this corresponds to the superior longitudinal sinus. On each side are *furrows* which present in their arrangement an arborescent appearance; these are occupied by branches of the middle meningeal artery. Small *depressions* on either side of the median line are commonly seen; these are for the lodgement of the external glands of Pacchioni.

On the external surface of the dura mater, the *situation* of the superior longitudinal sinus, the *ramifications* of the middle meningeal artery, and the *external glands* of *Pacchioni*, will be noticed. The dura mater is usually studded with points of blood caused by the rupture of vessels in the removal of the calvaria.

The Superior Longitudinal Sinus, Fig. 8, *b*, may now be laid open, and any coagulated blood which it may contain,

Fig. 8.

A View of the Sinuses of the Dura Mater.—*a*. The torcular Herophili. *b*. The superior longitudinal sinus. *c*. The inferior longitudinal sinus. *d*. The straight sinus. *e*. The venæ Galeni. *f*. The lateral sinus of the left side. *g*. The posterior occipital sinus. *h*. The superior petrosal sinus. *i*. The inferior petrosal sinus. *k*. The internal nasal veins.

washed out. It commences at the foramen cæcum, and extends to the torcular Herophili, Fig. 8, *a;* increasing in size from its commencement to its termination. When cut transversely, it presents a triangular figure, with the apex directed down-

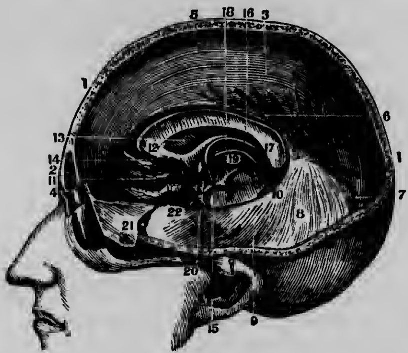
wards. The *middle glands* of *Pacchioni* are situated in it; often these are very small or entirely absent. The mouths of the veins of the pia mater will be seen opening into it. Fibrous bands stretch across it; they are called the *chordæ Willisii.* These cords, however, are not very distinct. The superior longitudinal sinus receives blood from the nose and frontal sinus, from the diploe, pericranium, and dura mater, as well as from the veins of the pia mater.

An incision should now be made through the dura mater corresponding to the one made in the bone for removing the calvaria. Raising it up on each side from the arachnoid, its serous surface will be observed, and, tracing it towards the median line, it will be found to be reflected down between the two hemispheres of the brain. This reflected or vertical portion is the *falx cerebri.* Before raising the falx, it will be necessary to divide the veins of the pia mater. It will be observed that many of these enter the longitudinal sinus in a direction from behind forwards; this arrangement has a tendency to prevent these veins being too rapidly emptied, which would be liable to cause syncope. The *internal glands* of *Pacchioni* are found on the inner surface of the dura mater, near the longitudinal sinus.

By separating the hemispheres a short distance, the falx, Fig. 9 (3), can be seen *in sitû.* Its lower border is concave, and corresponds to the upper surface of the corpus callosum, which it nearly touches behind. It is attached anteriorly to the crista galli, and posteriorly to the tentorium; its anterior extremity is quite narrow, while its posterior extremity is broad. The inferior or concave border contains the *inferior longitudinal sinus*, Fig. 8, *c*, which resembles in its form an ordinary vein. The falx may be divided just above its anterior attachment, and turned backwards out of the way for the present.

The upper part of the cerebrum is now covered by the arachnoid and pia mater, through which the convolutions are clearly seen. The size and direction of the veins of the pia mater may be noticed. On separating the hemispheres, the arachnoid will be seen reflected from one to the other without reaching to the bottom of the fissure. The pia mater lines the fissure throughout its whole extent. The arteries of the corpus callosum are seen resting on it anteriorly, but dividing into branches as they pass backwards.

Fig. 9.



1. Vertical section of the head. 2. The frontal sinus. 3. The falx cerebri. 4. Its origin from the crista galli. 5. Its attachment along the sagital suture. 6. The lower or concave edge of the falx. 7. Its continuation to the tentorium. 8. The tentorium. 9. Its attachment to the petrous portion of the temporal bone. 10. The free edge of the same part. 11. The convolutions of the right anterior lobe of the cerebrum. 12. The anterior extremity of the corpus callosum. 13. The septum lucidum. 14. Section of the anterior commissure. 15. Anterior crus of the fornix. 16. Middle of the fornix. 17. Its posterior extremity joining the corpus callosum. 18. Internal side of the thalamus nervi optici. 19. Section of the corpus striatum. 20. Lateral parietes of the third ventricle. 21. A portion of the dura mater turned off. 22. Section of the internal carotid artery.

Sect. V.—Dissection of the Brain.

By removing a portion of the arachnoid and pia mater above the corpus callosum, this body may be inspected before any dissection of the brain is made; its depth from the upper surface of the brain, and the distance of its anterior and posterior borders from the extremities of the cerebrum, are worthy of notice. It is important that the student obtains a distinct idea of the situation of this body in relation to the periphery of the brain, as it will assist him greatly in learning and fixing in his mind the exact location of many other parts. It is the great *starting point* in dissecting the central or figurative part of the brain from above downwards.

Before commencing the dissection of the cerebrum, the student may observe the appearance and general arrangement of the convolutions of the two hemispheres. The depth of the sulci, between the convolutions, is best seen from sec-

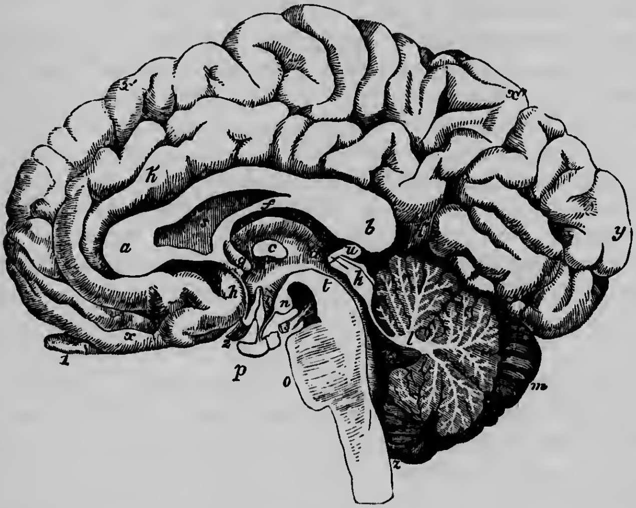
tions of the brain. The convolutions on the two sides do not exactly correspond in their direction or number. This, however, does not interfere at all with the functions of the organ.

The dissection of the brain is begun by making a horizontal transverse incision through one hemisphere on a level with the upper surface of the corpus callosum. In doing this, the corpus callosum is kept in view, and answers for a guide. The following points are now to be noticed: Just above the corpus callosum, and projecting somewhat over it, is a long convolution, not only extending the whole length of it, but bending downwards both before and behind, to terminate on the base of the brain. If the medullary substance in this convolution be examined in that portion of the hemisphere which has been removed, it will be found to contain longitudinal fibres. These fibres constitute the *superior longitudinal commissure*, and are supposed to connect, physiologically, the anterior, middle, and posterior portions of the hemisphere.

The CORPUS CALLOSUM, Fig. 10, is about three inches and a half in length. It is arched from before backwards, broader behind than before, and thinnest in the middle. Two *ridges* are seen on the upper surface, close to the median line, extending from its anterior to its posterior border; these ridges are not always parallel to each other. The *raphé* is situated in the median line. The *lineæ transversæ* are slight elevations extending from the longitudinal ridges to the lateral borders; they indicate the direction of the fibres of which the corpus callosum is composed. The termination of the corpus callosum, neither anteriorly nor posteriorly, can be seen at this stage of the dissection. It may be stated here, however, that it passes downwards and backwards, in front, to the lamina cinerea, or the anterior part of the floor of the third ventricle. Its reflected portion gradually diminishes in thickness to its termination. The term *genu*, or *knee*, has been applied to the junction of the horizontal and reflected portions, and *rostrum* to the lower part, just in front of the floor of the third ventricle. Posteriorly, it seems to be doubled upon itself, the lower or reflected part apparently terminating in the posterior extremity of the fornix, forming the upper boundary of the transverse fissure at this point. Laterally, the fibres of the corpus callosum are lost in the hemispheres.

The corpus callosum forms the roof of the two lateral ventricles, and has attached to its under surface, along the median line, the septum lucidum. The next thing to be done is to

Fig. 10.



A Vertical Section in the Median Plane, of the Cerebrum, Cerebellum, Pons, and Medulla Oblongata—the parts being all represented in their natural position.—*a*. Anterior, and *b*. Posterior extremity of corpus callosum, which is seen in section. *d, c, e*. Third ventricle. *c*. Soft commissure. *d, e*. Thalamus opticus, forming side of third ventricle. *f*. Fornix, united behind to corpus callosum. *b, g*. Anterior pillars of fornix. Between *g* and *h*, anterior commissure. Behind *h*, lamina cinerea. *h, h′, h″*. Convolution of corpus callosum or gyrus fornicatus. *i*. Infundibulum. *k*. Corpora quadrigemina, seen in section. *k* to *l*. Valve of Vieussens. *l*. Section of cerebellum, showing white and gray matter—appearance named arbor vitæ. *m*. Notch of cerebellum. *n*. Corpus albicans of right side. *o*. Pons Varolii (section). *p*. Pituitary body. *r*. Choroid plexus. *s*. Septum lucidum. *t*. Cerebral peduncle of right side, in section. *u*. Pineal gland. *v*. Cavity of fourth ventricle. *d* to *v*. Iter a tertio ad quartum ventriculum, or aqueduct of Sylvius. *x, x′, x″*. Marginal convolution of the longitudinal fissure. *y*. Posterior lobe of cerebrum. *z*. Opening leading into fourth ventricle. 1. Olfactory nerve. 2. Optic nerve divided through optic commissure. 3. Third nerve, or motor oculi.

expose the parts beneath the corpus callosum, without injuring them. As the septum lucidum is attached to this body, the central part of it must be allowed to remain while the lateral portions of it are removed. This can be done by making an incision through it on each side of the raphé, and about a line from the latter, from near the anterior to the pos-

terior border. Having cut into the ventricles, and observed the thickness of the corpus callosum, it may be reflected outwards on each side, or cut away with the scissors. The incision on each side should be extended backwards and outwards for a short distance in the direction of the lateral cornu, so as to expose more fully the ventricle and its contents.

The SEPTUM LUCIDUM, Fig. 10, *s*, will now be seen forming a vertical septum between the two lateral ventricles. By lifting up the central portion of the corpus callosum between the handles of two scalpels, and placing a light on the opposite side, its translucent character will be seen. It has the shape of a falx, with its broad extremity situated anteriorly, and its posterior extremity tapering to a point between the corpus callosum and fornix. It consists of two lamellæ of medullary substance, separated by a small space called the fifth ventricle.

The FIFTH VENTRICLE is situated in the anterior part of it; and to demonstrate it, the upper part of the septum should be cut away with the scissors. Sometimes the two lamellæ adhere to each other, and again they are separated by a small quantity of fluid. The fifth ventricle does not usually communicate with the third ventricle.

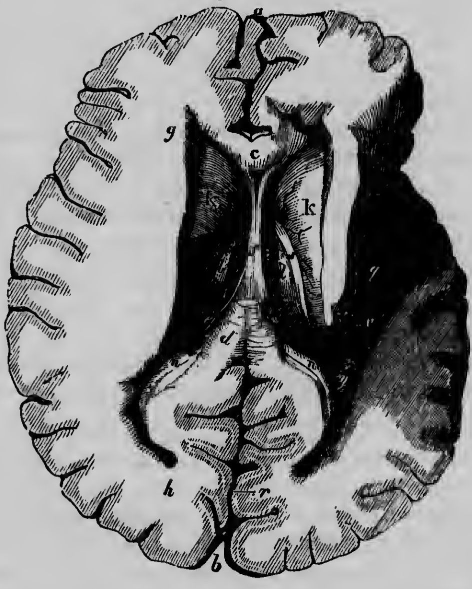
The LATERAL VENTRICLE, Fig. 11, on each side, consists of a body and three cornua, one for each lobe of the hemisphere. The *anterior cornu* is the space between the reflected portion of the corpus callosum and the anterior extremity of the corpus striatum. The examination of the posterior and middle cornua may be postponed until the body of the ventricle has been studied. The *body* presents three surfaces: the upper, or corpus callosum; the inner, or septum lucidum; and the lower, or floor, which is composed of several parts. Of these parts, there are five which deserve special notice. They are the corpus striatum, tænia semicircularis, thalamus opticus, plexus choroides, and fornix.

The CORPUS STRIATUM, Fig. 11, *k*, forms the outer and anterior part of the floor of the ventricle. It is pear-shaped, with the large extremity situated anteriorly, and the small extremity posteriorly. It is readily distinguished from the surrounding parts by its dark-grayish color. It is called the striated body, on account of the intermixture of gray and white substance in its structure, which gives to it a striated appearance

when it is cut into. The external portion of the brain corresponding to the corpus striatum is the *island of Reil*, in the fissure of Sylvius.

THE TÆNIA SEMICIRCULARIS, Fig. 11, *s*, is a narrow, whitish band, situated along the inner concave border of the corpus

Fig. 11.



SECTION OF CEREBRUM, DISPLAYING THE LATERAL VENTRICLES. ON THE RIGHT SIDE, THE DESCENDING CORNU IS LAID OPEN.—*a*, *b*. Parts of great longitudinal fissure. *c*. Section of front of corpus callosum. *d*. Part of posterior end of the same. *f*. The body of the fornix. *e*. The left choroid plexus. *g*. Anterior cornu, *h*, posterior, and *q*, descending cornu of the lateral ventricle. *k*, *k*. Corpora striata. *l*, *l*. Optic thalami. *n*, *n*. Right and left hippocampus minor. *o*. Posterior pillar of fornix, becoming continued as the corpus fimbriatum, *v*. *q*. Cornu Ammonis, or Pes hippocampi. *r*. Shows alternate gray and white layers in cortical substance. *s*, *s*. Right and left tænia semicircularis. *v*. Corpus fimbriatum. *y*. Eminentia collateralis.

striatum. It extends from the anterior cornu of the fornix to the posterior part of the thalamus opticus, where it is connected to the corpus geniculatum externum.

The THALAMUS NERVI OPTICI, Fig. 11, *l*, is seen on the inner side of the tænia semicircularis, by which it is separated from the posterior part of the corpus striatum. It is white,

and only a small portion of it is seen in the floor of the lateral ventricle.

The PLEXUS CHOROIDES, Fig. 11, *e*, is composed of vessels and areolar tissue, being a portion of the pia mater. It is situated on the inner side of the thalamus. It is red in the recent brain.

The FORNIX, Fig. 11, *f*, is a white body forming the inner part of the floor. Anteriorly, it is connected with the septum lucidum; and posteriorly, with the corpus callosum.

Besides these five bodies, the student may notice along the concave border of the corpus striatum a narrow, shining band, called the *Lamina Cornea*. This is apparently a thickening of the lining membrane of the ventricle. It is not always very distinct. Beneath this is a vein of considerable size, coming from the corpus striatum. The floors of the two lateral ventricles are perfectly symmetrical.

The POSTERIOR CORNU of the lateral ventricle, Fig. 11, *h*, is an extension into the posterior lobe. It proceeds outwards at first, and then inwards. Its floor is formed by a spur-shaped elevation called the HIPPOCAMPUS MINOR. The upper and lateral walls consist of white medullary substance.

The MIDDLE or INFERIOR CORNU, Fig. 11, *q*, is much larger. It curves outwards, downwards, and forwards around the posterior, outer and lower part of the thalamus. This cavity may be exposed by removing the upper and outer portion of the middle lobe down to a level with it; or it may be fully brought into view by making a single incision, cutting from within outwards, and following the course of the cornu from its commencement to its termination, and then lifting up that portion of the middle lobe situated above it. The following parts are found in the middle cornu.

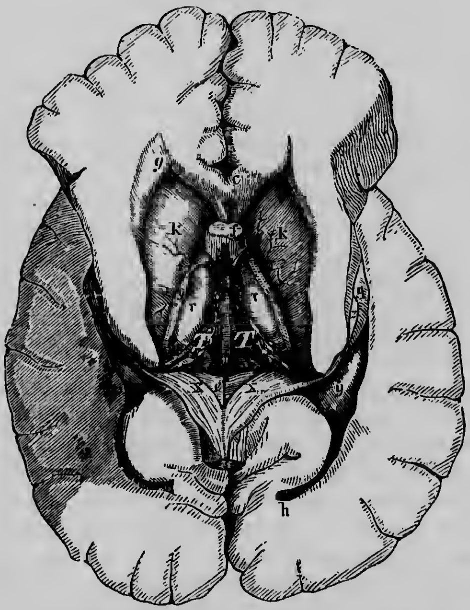
The *plexus choroides* extends into the middle cornu, and disappears there, by becoming continuous with the pia mater in the transverse fissure; this must be removed to expose the parts beneath it.

The HIPPOCAMPUS MAJOR extends the whole length of the floor, and terminates in an indented expansion, called the *pes hippocampi*. This body follows the curved direction of the cavity; presents a smooth white appearance, convex ex-

ternally and concave internally. This body is formed by the posterior and reflected portion of the convolution which was seen on the inner side of the hemisphere, immediately above the corpus callosum; it has a corresponding depression or sulcus on the base of the brain.

The Tænia Hippocampi, or Corpus Fimbriatum, is a narrow white band occupying the concave border of the hippo-

Fig. 12.



A Section of the Cerebral Hemispheres, showing both lateral ventricles, after the fornix has been divided and turned back, to expose the velum interpositum.—*c.* The anterior portion of corpus callosum, cut across. *e.* The lyra, or under surface of posterior part of corpus callosum. *f.* Anterior pillars of fornix cut across. N. B. These are represented of too great size. *g.* Anterior, *h,* posterior cornu of lateral ventricle. *k, k.* Corpora striata. *q.* Pes hippocampi. *r, r.* Thalami optici. *s, s.* Tænia semicircularis. *t, t.* Choroid plexuses. *v.* Velum interpositum. *x, x.* Posterior pillars of fornix. *y.* Eminentia collateralis.

campus major; it is a continuation of the posterior pillar of the fornix; its concave border is free, while its convex margin can usually be raised only slightly from the hippocampus.

When the free border of the corpus fimbriatum is raised up and turned over on the hippocampus, the CORPUS DENTATUM is brought into view. It is a reddish gray body, serrated, and lies within the concavity of the hippocampus.

The internal and upper wall of the middle cornu is formed by the thalamus opticus and corpus striatum. On the lower and posterior part of the thalamus may be observed two small bodies, the *corpus geniculatum, externum* and *internum.* The latter is located a little anterior to and below the former; it is also somewhat smaller, and of a paler appearance. These bodies are connected by white bands to the tubercula quadrigemina. The optic nerve arises in part from them.

Having observed the walls and contents of the lateral ventricles, the student may proceed with the dissection in the direction of the *third ventricle.*

This ventricle is situated under the fornix, which has not as yet been disturbed. By observing the point at which the plexus choroides on each side passes beneath the fornix, the position of the *foramen of Monroe* will be found, as it is occupied by the junction of the two plexuses. This foramen forms the only direct communication between the lateral ventricles, and also between them and the third ventricle.

Now divide the fornix over the foramen of Monroe, and carefully raise up and reflect one portion forwards and the other backwards. The union of the two plexuses will now be seen, and also a thin delicate membrane stretching across from one plexus to the other, and which lined the inferior surface of the fornix behind the foramen of Monroe; this is called the *velum interpositum*, Fig. 12, *v.* The handle of the scalpel should now be carried backwards between the fornix and the velum interpositum, separating the latter from the former, and also from the posterior border of the corpus callosum. On the under surface of the posterior part of the corpus callosum, and between the posterior pillars of the fornix, are several oblique lines, which constitute what is called the *lyra*, Fig. 12, *e.* By dividing what remains of the posterior part of the corpus callosum and fornix, in the direction of the median line, the connection between these two bodies may be examined; also the manner in which the fornix is connected on the sides with the two hippocampi and the corpora fimbriata. These last connections form the *poste-*

rior pillars, or *crura*, Fig. 12, *x*, *x*, of the fornix, of which there is one on each side. It will be observed that the borders of the central part of the fornix are entirely free, resting upon the plexuses and the velum interpositum. The anterior part of the fornix divides into two crura, which pass downwards towards the base of the brain. These will be seen more distinctly when the third ventricle is fairly exposed.

The velum interpositum may now be raised and reflected backwards, observing, at the same time, two veins, the *venæ Galeni*, Fig. 8, *e*, occupying the centre of it. These veins collect the blood from the different bodies in the ventricles and convey it into the sinus rectus. In separating the pia mater from the substance of the brain, care should always be taken to divide with the scalpel or scissors any small vessels which are not readily broken. In raising the posterior part of the velum, it should be borne in mind that it is closely connected to the *pineal gland*, and that this part of it, therefore, should be dissected, and not torn away. With a little care, and by using the forceps and scissors, the student will be able to preserve this small body with its connections to the thalami and posterior commissure of the third ventricle.

The THIRD VENTRICLE, Fig. 13, *z* to *s*, should now be examined. It is located between the thalami nervorum opticorum and below the fornix and velum interpositum; the locus perforatus medius, eminentiæ mammillares, and tuber cinereum, which are seen on the base of the brain, are placed immediately below it. It contains three commissures, an *anterior*, a *middle*, and a *posterior*. The middle one is not a true commissure; it consists of gray substance, formed apparently by a mere adhesion of the two thalami. It is apt to be broken away in separating the bodies to expose the other parts in the ventricle. It is sometimes absent. In the anterior part of the ventricle are seen, first, the *anterior crura* of the fornix, having a vertical direction; second, in front of, and between these, the *anterior commissure*, a small transverse cylindrical body connecting the corpora striata and the convolutions of the middle lobes; and third, below this, and between the crura, the *opening* which leads into the infundibulum. In the posterior part are observed, first, the *peduncles* of the pineal gland, which extend forwards along the inner margins of the thalami, to which they adhere, to connect with the anterior crura of the fornix and the tænia semi-

circulares; second, the *posterior commissure*, a white, cylindrical body, which connects the two thalami; third, just beneath this, the *aqueduct of Sylvius*, or the opening which leads to the fourth ventricle. The floor of the third ventricle is only

Fig. 13.

Section of the Cerebrum displaying the Surfaces of the Corpora Striata, and Optic Thalami, the Cavity of the Third Ventricle, and the Upper Surface of the Cerebellum.—*a, e.* Tubercula quadrigemina—*e*, testis, *a*, nates. *c.* Corpus callosum. *f.* Anterior pillars of fornix. *g.* Anterior cornu of lateral ventricle. *k, k.* Corpora striata. *l, l.* Optic thalami. * Anterior tubercle of the left thalamus. *z* to *s*. Third ventricle. In front of *z*, anterior commissure. *b.* Soft commissure. *s.* Posterior commissure. *p.* Pineal gland with its peduncles. *n, n.* Processus cerebelli ad testes. *m, m.* Hemispheres of the cerebellum. *h.* Superior vermiform process. *i.* Notch behind the cerebellum.

about a line in thickness, so that this cavity is situated very near to the basilar surface of the brain.

The Pineal Gland, Fig. 13, *p*, has already been exposed. It is of a pyriform shape, with its base turned forwards and upwards, and consists of gray matter, which contains small,

calcareous bodies. It generally contains a small cavity. It rests on the tubercula quadrigemina, and beneath the posterior border of the corpus callosum.

Directly behind the third ventricle are found the TUBERCULA QUADRIGEMINA, Fig. 13, *a*, *e*. They consist of four round tubercles or elevations, separated on the surface by grooves, but joined at their bases. They occupy a plane inclined obliquely backwards and downwards. The anterior and superior are called *nates;* the posterior and inferior are named *testes*, and are smaller than the nates. They, with the posterior commissure, form the roof of the way from the third to the fourth ventricle, or the aqueduct of Sylvius.

Before proceeding further with the dissection, it will be necessary to remove the encephalon from the cavity of the cranium. It might be taken out before the dissection of the cerebrum is commenced. This is not necessary, however, if it can be examined when fresh, or if the subject has previously been injected with solution of chloride of zinc. To remove the encephalon, the subject should be placed on the back, with a block under the shoulders, so that the head can be depressed sufficiently to allow it to rest on one hand, while the vessels, nerves, &c., are divided with the other.

In raising the anterior lobes, the *bulbs* of the olfactory nerves must be removed with some care from the cribriform fossæ; or they may be allowed to remain for the purpose of examining them afterwards *in situ*. The *optic nerves* must be divided at the sella turcica, just before they enter the optic foramina; also the *internal carotids*. Immediately behind the optic chiasm, which will now be seen, is the *infundibulum*, extending from the tuber cinereum, on the base of the brain, to the pituitary gland, which occupies the sella turcica; this may be cut across, if it be desired to examine the gland *in situ*, otherwise the scalpel may be carried around it so as to remove the greater part of it in connection with the infundibulum. The whole of the pituitary body cannot well be dissected out without cutting away the posterior clinoid processes. The infundibulum is very easily broken, hence some care is necessary to preserve it. The *third pair* of nerves will be seen perforating the dura mater behind, and outside of the posterior clinoid processes. The *fourth pair* run along the margin of the tentorium; they are very small,

and usually lie concealed just beneath its edge. The *fifth pair* are large, and perforate the dura mater a little below the margin of the tentorium; they are readily exposed by cutting through the tentorium directly over them. The *sixth pair* are much smaller, and will be seen a little further back and nearer to the median line. The *seventh pair* are situated more externally, and nearer to the petrous portion of the temporal bone. The *eighth pair* consist of several fasciculi, and are a little nearer to the median line and further back than the preceding. The *ninth pair* will be observed near the foramen occipitale. These nerves must all be divided, as they are brought into view, with a sharp scalpel or with the scissors. The tentorium must be cut through on each side before all the nerves can be divided. The spinal marrow is to be cut across by carrying the scalpel as far down as convenient through the occipital foramen, care being taken, at the same time, to sever the vertebral arteries. Having divided all these parts, the brain is easily removed by carrying one or two fingers down so as to dislodge the medulla oblongata and cerebellum, while the whole is steadied and carefully supported with the other hand. It is hardly necessary to remind the student of the necessity of handling the encephalon with great care, in order to preserve it entire.

If the cerebellum now be pushed a little backwards, and away from the testes, the *valve* of the brain and the *processus cerebelli ad testes*, Fig. 13, *n*, will be seen. To obtain a good view of these, the student may divide the cerebellum in the median line and down to a level with the valve. Having examined the valve *in situ*, he may continue the incision to near the base of the cerebellum. Thus, dividing this organ need not interfere with its examination at another time.

The interior of the FOURTH VENTRICLE, Fig. 10, *v*, Fig. 16, will be distinctly seen by separating the two halves of the cerebellum. It consists of a lozenge-shaped space, situated behind and below the tubercula quadrigemina, which separate it from the third ventricle. Its boundaries are formed by the *medulla oblongata*, the *cerebellum*, and the *cerebrum*, so that it may be regarded as a space occurring incidentally between all these parts. The object to be gained by studying it as a cavity is simply to learn the location of the parts with which it is in relation.

Its *floor* is formed by the upper and posterior surface of the medulla oblongata; its *roof* is arched from above down-

wards and from before backwards, and may be considered as curved laterally with the concavity looking towards the ventricle.

The following parts enter into the formation of its roof:—

In the *upper* and *anterior* part are the valve of the brain and the processus cerebelli ad testes. The VALVE is of a triangular shape, the apex being joined above by a narrow band to the testes, the base to the cerebellum, and the sides to the processus cerebelli ad testes. It consists of a thin white lamina, covered by a layer of gray substance. Its upper surface, especially near the base, presents several transverse ridges, resembling the lamellated arrangement of the cerebellum. The FOURTH PAIR of nerves arise from it and the processes on its sides.

The PROCESSUS CEREBELLI AD TESTES are two bands of medullary fibres, one extending from the centre of each hemisphere of the cerebellum to the testes, and through them to the cerebrum. In the *lower* and *posterior* part of the roof there are, in the median line, two projections; the upper one is named the *nodulus*, the lower one the *uvula*. These prominences are situated on the inferior vermiform process on the lower part of the median lobe of the cerebellum. On each side of the uvula, and united to it, is a small protuberance termed the *tonsil*. Extending from the flocculus or pneumogastric lobe on the one side, to the nodulus in the centre, and thence across to the corresponding lobe of the opposite side, may be seen a thin, white, delicate membrane, composed of transverse fibres, and named the *posterior medullary velum*. It forms a commissural connection between the parts with which it is connected. It presents a free, concave border, which looks into the ventricle.

The following points are observed in the floor of the fourth ventricle: A fissure is seen in the median line extending from the lower orifice of the aqueduct of Sylvius above, to a slight depression in the medulla oblongata called the *ventricle of Arantius*. The lower part of this fissure is named the *calamus scriptorius*. The whole length of the fissure is about an inch and a half. The corpora restiformia commence at the ventricle of Arantius, and diverge as they pass upwards and outwards to enter the cerebellum. In the upper part are the crura cerebelli, which are composed of the transverse medullary fibres of the pons Varolii, and are here seen

entering the cerebellum. The *posterior pyramids* are two bodies, one on each side of the lower part of the fissure. The superior surface of the pons Varolii forms a part of the floor just behind and below the tubercula quadrigemina. The fasciculi innominati, or corpora teretes, also pass up through the posterior part of the medulla oblongata, and in the floor of the fourth ventricle. In the lower part of the floor are observed white transverse fibres, called *lineæ transversæ*. The PORTIO MOLLIS arises in part from some of these fibres. A thin layer of gray neurine covers the greater part of the walls of this cavity, and the whole is lined by a serous membrane, which is continued into the third ventricle through the aqueduct of Sylvius, but not into the subarachnoid space immediately below.

The pia mater sends into the fourth ventricle two prolongations called *choroid plexuses*. Before proceeding farther with the dissection, the reflection of the arachnoid from the cerebellum to the medulla oblongata should be noticed. Quite a space is left beneath it, occupied principally by areolar tissue. This is called the *posterior subarachnoid space*. It will be observed that the arachnoid adheres closely to the surface of the medulla oblongata, so that fluid cannot readily pass from the posterior subarachnoid space in the cranium, to the one in the spinal canal. It may be remarked here, that the subarachnoid spaces in the cranium communicate for the most part freely with each other.

THE CEREBELLUM.

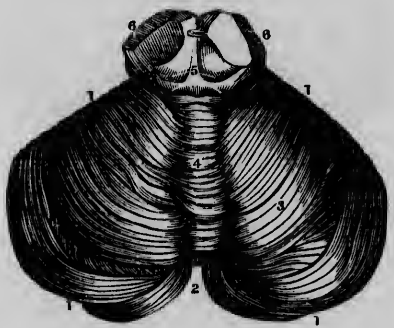
The dissection of the CEREBELLUM may now be commenced. Some of its parts have already been noticed in connection with the fourth ventricle. Its location and relations in the cranial cavity were seen at the time the encephalon was removed. It differs in form and external appearance very materially from the cerebrum. Its transverse diameter is greater than the antero-posterior, while its two hemispheres are connected above and below by elevations. Instead of convolutions, its exterior surface presents numerous concentric lamellæ separated by sulci; these have, for the most part, a transverse direction, and are more numerous on the upper than on the lower surface. It is composed of white medullary substance internally, and gray matter externally. The

gray substance, however, does not cover the bottoms of the deep sulci. Its superior and inferior surfaces are separated by a well marked border, and a deep horizontal fissure. It presents two notches, one before for the tubercula quadrigemina and the crura cerebelli, and one behind for the falx cerebelli and inferior occipital ridge. The posterior notch terminates below and anteriorly in an excavation which corresponds to the medulla oblongata.

The two hemispheres are united by a *median lobe*, the upper part of which is termed the *superior vermiform process*, and the lower part the *inferior vermiform process*. The upper surface is sloping from the centre, while the under surface of each hemisphere is convex, and separated by a deep depression, named the *vallecula*, or *valley*.

The *superior* surface, Fig. 14, of each hemisphere presents two lobes; an *anterior*, or *square lobe*, and a *posterior*, or *semi-*

Fig. 14.



A VIEW OF THE SUPERIOR FACE OF THE CEREBELLUM.—1,1. The circumference of the cerebellum. 2. The space between its hemispheres behind. 3. One of the hemispheres of the cerebellum, showing the lamellæ which compose it. 4. The superior vermiform process. 5. The tubercula quadrigemina. 6. Section of the crura cerebri.

lunar lobe, divided by a deep sulcus. The two anterior lobes are connected to each other by the transverse laminæ of the superior vermiform proccss, which is situated between them. The two posterior lobes are separated from each other by the posterior notch, but are connected to each other by transverse bands at the bottom of the notch. These lobes consist of lobules, which again are composed of laminæ.

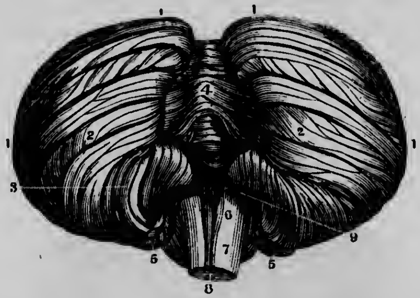
The *inferior* surface, Fig. 15, of each hemisphere presents five lobes separated by sulci.

The *inferior posterior lobe* is situated immediately below the superior posterior, and separated from its fellow by the posterior notch.

The *digastric lobe* is larger, and is seen near the anterior and external border of the hemisphere. This lobe is connected to its fellow on the opposite side by transverse lamellæ, which extend through the pyramid across the valley. Its outer extremity is broad, and divided into two parts.

The *gracilis lobe* is situated between the two preceding. It has a transverse direction.

Fig. 15.



A View of the Inferior Surface of the Cerebellum and a portion of the Medulla Oblongata.—1,1. The circumference of the cerebellum. 2,2. The two hemispheres of the cerebellum. 3. Lobus amygdaloides. 4. The inferior vermiform process. 5. Lobus nervi pneumogastrici. 6. The calamus scriptorius. 7. Its point. 8. Section of the medulla oblongata. 9. Points to the origin of the pneumogastric nerve.

The *flocculus*, or *pneumogastric lobe*, Fig. 15 (5), is attached to the hemisphere by a pedicle. It is situated anteriorly by the side of the valley, and just behind the crus cerebelli, close to the eighth nerve. Its surface is divided into small lamellæ. The two flocculi, as before mentioned, are connected to each other by the posterior medullary velum.

The *amygdaloid*, or *tonsillitic lobes*, were seen in the dissection of the fourth ventricle. These two lobes form the lateral boundaries of the valley, and are connected to each other by the uvula.

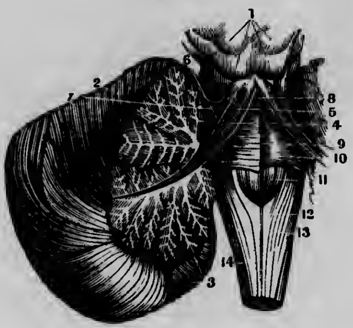
The *superior vermiform process* extends from the posterior

to the anterior notch. It is much larger anteriorly where it overhangs the valve of the brain, and is in apposition with the tubercula quadrigemina, than it is posteriorly. It is crossed by curved lamellæ, which are convex anteriorly.

The *inferior vermiform process* has a crucial form. The posterior limb projects backwards in the posterior notch, the anterior extends forwards into the fourth ventricle, while the lateral or transverse are connected to the hemispheres. It presents in the median line three prominences: the *pyramid* behind, next to this, in front, the *uvula*, and anterior to this the *nodulus*. The last two form a portion of the roof of the fourth ventricle.

The internal structure of the cerebellum may be seen by making two vertical incisions from before backwards, commencing at the anterior notch. One of these incisions should divide the middle lobe in the median line; the other

Fig. 16.



A View of the Arbor Vitæ and the Fundamental Portion of the Cerebellum, together with the Floor of the Fourth Ventricle.—1. The tubercula quadrigemina. 2. The superior surface of the cerebellum. 3. Its inferior surface, and also the arbor vitæ. In the trunk of the arbor vitæ are seen three fasciculi running up to the tubercula quadrigemina. The most internal of these is—4. A fibrous layer, in which are collected all the filaments which pass from the parietes of the aqueduct of Sylvius to the inferior vermiform process. 5 Is the fasciculus outside of the preceding, which runs from the trunk of the arbor vitæ behind the tubercula quadrigemina. 6 Is that from which all the fasciculi of the superior vermiform process pass to the tubercula quadrigemina. 7. A very delicate medullary layer, which passes from the anterior surface of the crus cerebelli under the cineritious matter of the cerebrum. 8. The anterior extremity of the fourth ventricle, drawn back and leading to the aqueduct of Sylvius. 9. Middle furrow on the floor of the fourth ventricle. 10. Tracts of nervous matter, running to the auditory nerve. 11. Elevated portion of the same on the floor of the fourth ventricle. 12. Middle fissure on the calamus scriptorius. 13. Corpora Restiformia. 14. Lateral portion of the spinal marrow.

should be carried through one of the hemispheres so as to leave about one-third of it on the inner side, and two-thirds on the outer side. The arrangement of the white or medullary substance is distinctly seen on the surfaces of these sections. It presents, in both, a beautiful arborescent appearance, which has been named the *arbor vitæ.* The one in the middle lobe is the *middle arbor vitæ*, and the one in the hemisphere, the *lateral arbor vitæ.* The central mass is the trunk of the tree, and from this spring branches, which divide into smaller branches, and these again into twigs and leaflets. In this way the medullary fibres diverge from the centre to the periphery, so as to be placed in connection with a large extent of cineritious surface. In the centre of the trunk of the lateral arbor vitæ is a mass of grayish-yellow matter, with indented edges; this is the *corpus dentatum*, *corpus rhomboideum*, or the *ganglion* of the cerebellum. It consists of a capsule of gray substance, filled with white fibres, intermixed with gray neurine. The capsule is perforated anteriorly by the fibres of the corpus restiforme.

The CEREBELLUM is about one-eighth the size of the cerebrum. Its white central mass is connected with the cerebrum, through the *processus cerebelli ad testes*, and with the medulla oblongata, through the *corpora restiformia* and the *arciform fibres* which come from the corpora pyramidalia; the two hemispheres are connected by the *transverse fibres* of the pons Varolii. These commissural fasciculi should be carefully observed by the student, as it is through them entirely that the cerebellum is placed in relation with the other parts of the nervous system.

The MEDULLA OBLONGATA, Fig. 17 (13), may next be examined. This consists of an intermediate section between the spinal marrow and the cerebrum and cerebellum; it is a sort of unfolding of the spinal marrow preparatory to the continuation of its fibres upwards into the two bodies just mentioned. Although it is convenient to speak of it as a distinct part, the student should bear in mind that it is merely a portion of one continuous structure. It gives origin, it is true, to nerves which have specific functions, but this does not, in an anatomical point of view, isolate it at all from other parts with which it is structurally connected.

It commences just below the foramen occipitale, and extends

upwards to the pons Varolii. Its direction corresponds to the inner surface of the cuneiform process of the occipital bone and the commencement of the spinal canal. Anteriorly and laterally, it is simply covered by pia mater and arachnoid membrane; posteriorly, it is, as has already been seen, in relation with the cerebellum and fourth ventricle.

Each lateral half presents four elevations or bodies, named *corpus pyramidale*, *corpus olivare*, *corpus restiforme*, and *corpus pyramidale posterius*. The two anterior pyramidal bodies are separated by a fissure, which is a continuation of the anterior fissure of the spinal marrow. At the bottom of this fissure are observed transverse commissural fibres; and, about an inch below the upper extremity, are seen several fasciculi, which decussate, connecting each half of the spinal marrow with the opposite hemisphere of the brain. The two posterior pyramidal bodies are also separated by a fissure, which is a continuation of the posterior fissure of the spinal marrow. A part of this fissure is the *calamus scriptorius*.

The Corpora Pyramidalia, Fig. 17 (20), are a continuation of the anterior columns of the spinal marrow upwards. They increase in size up to the pons Varolii, where they become suddenly constricted, and immediately enter that body. They diverge slightly as they ascend. At the upper end of the fissure, and between their upper extremities, is a small depression, called the *foramen cæcum*. Each body is composed of fibres coming from the anterior column of the spinal marrow of its own side, and also of fibres from that of the opposite side. These fibres continue upwards, through the pons Varolii and crura cerebri, to the cerebral hemispheres.

The Corpora Olivaria, Fig. 17 (22), are situated behind, and external to the anterior pyramids. They do not extend quite up to the pons; nor are they quite as long as the pyramids. The upper extremities are more prominent than the lower. Externally, they consist of white fibrous tissue; internally, each contains a mass of gray substance called the *olivary ganglion*, or *corpus dentatum* of the olivary body. The structure and appearance of this is similar to the corpus dentatum of the cerebellum. On the inner side, its capsule is open, and the gray matter which it contains is continuous with that of the centre of the medulla oblongata; it is also continuous with the gray substance of the pons. The fibres of the olivary bodies are continued upwards into the upper and posterior

part of the crura cerebri, and thence to the optic thalami and tubercula quadrigemina. The two olivary bodies are joined to each other behind the anterior pyramids, and form a part of the floor of the fourth ventricle.

The CORPORA RESTIFORMIA, Fig. 17 (21), are observed behind the olivary bodies. They are separated from each other, below, by the posterior median fissure, and, above, by the fourth ventricle. They are a continuation of the posterior lateral columns of the spinal cord upwards to the ganglia of the cerebellum.

The CORPORA PYRAMIDALIA POSTERIORA, or INNOMINATA, are seen in the floor of the fourth ventricle, one on each side of the median fissure. Their fibres extend upwards to the cerebrum.

The ARCIFORM FIBRES arise from the anterior pyramids, and, curving round the olivary bodies, join the corpora restiformia. They are very irregular. Sometimes they are seen above and below the olivary bodies, and again they spread out over them.

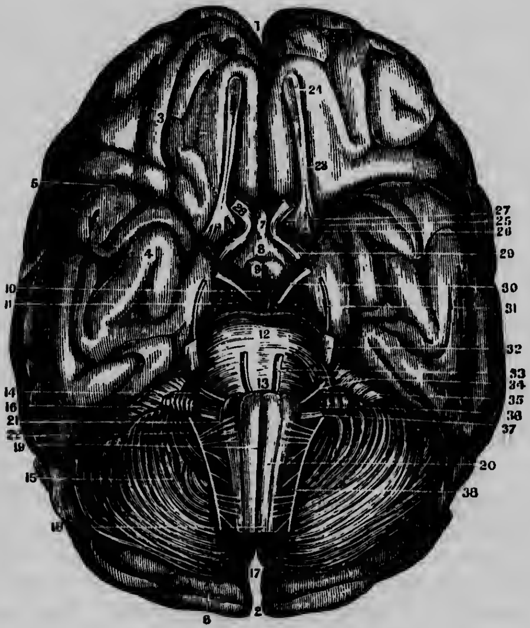
The grooves, between which the olivary body on each side is situated, are occupied by the roots of nerves.

The BASE of the brain may now be examined. There are three *subarachnoid* spaces to be noticed, in the first place, on the base of the brain. The two *lateral* are formed by the arachnoid passing from the lower surfaces of the middle to the anterior lobes, without dipping into the fissures of Sylvius. The *anterior* is situated in front of the pons Varolii, and between the middle lobes. These spaces are filled with loose areolar tissue, and are capable of containing a considerable quantity of serum. The arachnoid, where it is reflected to form these spaces, is quite thick and strong.

The *under* surface of the brain, it will be observed, presents an appearance very different from the upper. Taking the *encephalon*, the following prominent points will be noticed: On the sides, are the anterior and middle lobes of the cerebrum, separated by the fissures of Sylvius; behind the middle lobes, and separated from them by the transverse fissure, are the hemispheres of the cerebellum. Thus, the encephalon presents *six prominent parts*, situated laterally on its inferior surface. In the space between these parts, and occupying the centre, are the following, commencing posteriorly: The medulla oblongata, situated between

the hemispheres of the cerebellum; directly in front of this, the pons Varolii; anterior to it, the crura cerebri, and, be-

Fig. 17.



A VIEW OF THE BASE OF THE CEREBRUM AND CEREBELLUM, TOGETHER WITH THEIR NERVES.—1. Anterior extremity of the fissure which separates the hemispheres of the brain. 2. Posterior extremity of the same fissure. 3. Anterior lobe of the cerebrum. 4. Its middle lobe. 5. Fissure of Sylvius. 6. Posterior lobe of the cerebrum. 7. A part of the infundibulum. 8. Tuber cinereum. 9. Corpora albicantia. 10. Pons Tarini. 11. Crura cerebri. 12. Pons Varolii. 13. The top of the medulla oblongata. 14. Posterior prolongation of the pons Varolii. 15. Middle of the cerebellum. 16. Anterior part of the cerebellum. 17. Its posterior part, and the fissure of its hemispheres. 18. Superior part of the medulla spinalis. 19. Middle fissure of the medulla oblongata. 20. Corpus pyramidale. 21. Corpus restiforme. 22. Corpus olivare. 23. Olfactory nerve. 24. Its bulb. 25. Its external root. 26. Its middle root. 27. Its internal root. 28. Optic nerve beyond the chiasm. 29. Optic nerve behind the chiasm. 30. Motor oculi, or third pair of nerves. 31. Fourth pair, or pathetic nerves. 32. Fifth pair, or trigeminus nerves. 33. Sixth pair, or motor externus. 34. Facial nerve. 35. Auditory nerve. 36, 37, 38. Eighth pair of nerves. (The ninth pair are not seen.)

tween them, the locus perforatus medius and the eminentiæ mammillares; in front of the eminentiæ, the tuber cinereum,

which is placed between the optic tracts, and behind the optic chiasm; in front of the chiasm is the fissure which separates the anterior lobes; on the outside of each optic tract is the commencement of the fissure of Sylvius, with the locus perforatus lateralis and the peduncle of the corpus callosum. The relative position of these different parts on the base of the encephalon, should be carefully noted by the student.

The PONS VAROLII, Fig. 17 (12), contains the fibres which constitute the great commissure between the hemispheres of the cerebellum, and also the fibres which are prolonged from the medulla oblongata upwards into the crura cerebri. Besides these two sets of fibres, more or less gray substance is found in it, in which other fibres are said to originate.

It has directly above it the upper portion of the fourth ventricle, the tubercula quadrigemina, and the aqueduct of Sylvius. Its lower surface is free, and corresponds to the upper part of the basilar process of the occipital bone. Below and behind it is the medulla oblongata. In front of it are the crura cerebri. Laterally it terminates in the middle peduncles of the cerebellum.

When the pons is cut into, the transverse fibres are found to be intersected by longitudinal fasciculi, which are easily traced from the corpora pyramidalia upwards to the crura cerebri. The transverse fibres which are placed above the longitudinal fasciculi have gray substance intermixed with them. This gray substance is also intermixed with the fibres, which are prolonged upwards from the corpora olivaria. Above the gray substance are the fibres which proceed from the corpora innominata to the upper part of the crura cerebri.

The CRURA CEREBRI, or the PEDUNCLES OF THE CEREBRUM, Fig. 17 (11), are two large white bodies placed in front of the pons Varolii. They are to be regarded as a continuation of the spinal marrow upwards to the base of the cerebrum. They consist of white fibres which have ascended through the pons from the medulla oblongata and those which have originated in the pons, together with a mass of gray matter in each crus named the *locus niger*. The inferior fibres are a continuation of those which compose the corpora pyramidalia; the superior fibres are a continuation of those of the corpora olivaria and innominata. The gray matter is situated between these two sets of fibres, and in the central part of each crus. The gray

matter of the two crura is connected by the pons Tarini. It is continuous below with the gray neurine of the pons, medulla oblongata, and spinal marrow, and above, with that of the corpora striata and optic thalami.

If the fibres of the crura be traced upwards into the cerebral hemispheres, they will be found to enter the gray matter of the corpora striata and optic thalami; the inferior fibres, or those from the corpora pyramidalia, pass into the striated bodies, and the superior fibres, or those from the corpora olivaria and innominata, into the optic beds. This is true, however, only to a certain extent. The termination of these fibres in the optic thalami and striated bodies varies; some seem to form a plexiform arrangement in them. The corpora striata and optic thalami are the great *central ganglia* of the cerebral hemispheres; their gray matter forms really but a single mass in each hemisphere, and the masses of the two hemispheres are joined together by the commissura mollis of the third ventricle; in the same manner the loci nigri, in the crura cerebri, are connected by the pons Tarini; the lateral gray masses of the pons Varolii are joined together, and the medulla oblongata and the spinal marrow are also united in the median line by gray substance.

Thus the student will see that the white fibres, as well as the gray neurine of the spinal cord, are continued through the medulla oblongata, pons Varolii, and crura cerebri, up into the corpora striata and optic thalami; that although the fibres may change their relative position, and the gray neurine appear in different forms, yet they present an unbroken continuity.

The LOCUS PERFORATUS MEDIUS, or PONS TARINI, Fig. 17 (10), is of a gray color. It is placed between the base of the brain and the posterior part of the third ventricle, and is perforated by numerous small arteries. It is very thin, and easily broken through. It was called 'pons' by Tarinus, because it extended across from one crus cerebri to the other.

The CORPORA MAMMILLARIA, or CORPORA ALBICANTIA, Fig. 17 (9), are two small round bodies, white externally and gray internally. The white matter is the termination of the anterior cornua of the fornix on the base of the brain; the fibres of the fornix do not, however, end in these bodies, but are reflected upwards and backwards to the upper part of the thalami.

The TUBER CINEREUM, Fig. 17 (8), is a thin mass of gray matter behind the optic chiasm and in the floor of the third ventricle. From the centre of this projects downwards the *infundibulum.* This is of a reddish gray color, of a conical shape, terminating below in the pituitary gland, and opening above into the anterior part of the third ventricle. Its upper extremity only is hollow, at least, as a general thing, in the adult brain.

The PITUITARY GLAND occupies the sella turcica. It is a small body, consisting of an anterior and a posterior lobe. The anterior lobe is kidney-shaped, and composed of a yellowish substance; the posterior lobe is partly received into the anterior. This body is hollow in the fœtus, and communicates with the third ventricle through the infundibulum. It is covered by a layer of the dura mater. To dissect it *in situ*, the posterior clinoid processes should be broken away.

When the optic chiasm is raised, a thin layer of gray substance is seen, called the *lamina cinerea.* This extends from the tuber cinereum behind to the corpus callosum in front. Laterally, it joins on each side the perforated place at the inner extremity of the fissure of Sylvius. Its upper surface looks into the anterior part of the third ventricle. The chiasm of the optic nerves is connected by gray matter to the lamina cinerea.

On the sides of the lamina cinerea, and crossing the lateral perforated places, are seen two white fibrous bands, which pass forwards to terminate in the anterior border of the corpus callosum. These are named the *peduncles of the corpus callosum.*

The LOCI PERFORATI LATERALES are situated, one at the commencement of each fissure of Sylvius. They are perforated by numerous small arteries which are intended, mostly, for the supply of the corpora striata.

The FISSURE OF SYLVIUS, Fig. 17 (5), separates the anterior and middle lobes. It serves to increase greatly the exterior surface of the brain and the number of convolutions. As it passes outwards, it divides into two branches, which surround several small convolutions. These constitute the *island of Reil.* They correspond to the outer part of the corpus striatum.

The LOBES of the cerebrum, Fig. 17 (3, 4, 6), are six in number, three for each hemisphere. These are not seen on the upper part of the brain, and even on the base there is no natural line of separation between the posterior and middle. The middle is the most prominent; it occupies the middle fossa in the base of the cranium. The posterior rests on the tentorium, which separates it from the cerebellum, and at the same time supports it. The anterior lobe lies on the orbital portion of the frontal bone. It is separated from the corresponding lobe on the opposite side by the great longitudinal fissure. The two posterior lobes are separated from each other by the same fissure. The extent of this fissure is worthy of notice. No one can have any correct idea of the number of convolutions or the extent of exterior surface which each hemisphere of the cerebrum presents, without a knowledge of this fissure.

The GREAT TRANSVERSE FISSURE separates the posterior lobes from the cerebellum. It opens into the central excavation in front of the pons Varolii, passing round on each side of that body, and under the crura cerebri. This fissure leads into the middle cornu of each lateral ventricle, and also into the third ventricle, beneath the posterior border of the corpus callosum. It is in this part of the transverse fissure that Bichat described a communication between the cavity of the lining membrane of the third ventricle and the cavity of the arachnoid, external to the brain. It is called the *Canal of Bichat.* This anatomist described this communication as being of a tubular form, and surrounding the venæ Galeni. There can be no doubt that it does exist in some cases.

ORIGIN OF THE CEREBRAL NERVES.

The cerebral nerves consist of nine pairs. With the exception of the spinal accessory, a part of the eighth pair, they all arise from some part of the encephalon; they escape from the cranial cavity through different foramina. There is no difference between the corresponding nerves of the two sides. Although each pair has a particular name, they are generally designated by numbers—as first, second, third, &c.

The FIRST PAIR, or OLFACTORY NERVES, Fig. 17 (23), have

each three roots—one arising from the fissure of Sylvius, another from the corpus striatum, and the third from the posterior convolutions of the anterior lobe. The last one is situated between the others, and consists of gray matter. The trunk formed by the union of these three roots runs forward about two inches on the under surface of the anterior lobe, and then swells into a bulb, which rests on the cribriform plate of the ethmoid bone. The olfactory nerves are of a prismatic form, each being lodged in a groove on the under surface of the anterior lobe, to which it is bound by the arachnoid membrane passing over it, but not around it. They are composed of white and gray substance, and are softer than the other nerves. The bulbs are called the *olfactory lobes*, and might very properly be considered the true origin of the olfactory nerves. The filaments arise from the bulbs in two series on each side, and pass through the cribriform plate of the ethmoid, the *outer* series to the external wall, and the *inner* to the internal wall of the nasal fossa.

The SECOND PAIR, or OPTIC, Fig. 17 (28), arise from the tubercula quadrigemina, corpora geniculata, and optic thalami. The part between the origin of each nerve and the chiasm is called the *optic tract.* This is soft and flattened, and rests on the crus cerebri, to which it adheres slightly. The part anterior to the *chiasm* is round, and invested by neurilemma. The optic tracts converge towards the chiasm, while the optic nerves diverge as they proceed towards the orbits. The chiasm is formed by a decussation of the inner fibres of each nerve, while the outer fibres continue on without crossing. The chiasm is connected to the tuber cinereum by a few fibres. Transverse fibres have been described in this commissure. As the optic nerves pass through the optic foramina, the neurilemma is continuous with the periosteum lining the orbits; also with the sclerotic coat, as each nerve enters the ball of the eye.

The THIRD PAIR, or OCULO MOTOR, Fig. 17 (30), arise from the crura cerebri, near the pons Tarini. They can be traced into the substance of the crura, to the gray matter, or loci nigri. Each nerve consists of a round white cord, passes through the wall of the outer part of the cavernous sinus, and enters the orbit through the foramen sphenoidale, to be distributed to the superior, internal, and inferior recti muscles;

also to the inferior oblique and the levator of the upper eyelid.

The Fourth Pair, or Pathetic, Fig. 17 (31), arise from the valve of Vieussens and processus cerebelli ad testes. They are very small, and thread-like. Each passes through the walls of the cavernous sinus, and sphenoidal foramen to go to the superior oblique muscle of the eyeball. These nerves are so small and delicate, that the student must be very careful in tracing them, or he will either break or lose sight of them.

The Fifth Pair, Trifacial, or Trigeminal, Fig. 17 (32), have each two roots, arising apparently from the pons Varolii. The small root consists of motor filaments, and is situated above the large or sensor. The sensor portion of this nerve can be traced to near the floor of the fourth ventricle, or to the corpus innominatum; the motor portion is connected in its origin with the fibres of the corpus pyramidale, with which it is associated in function. The two roots, after leaving the pons, unite to form a large cord or fasciculus, which passes beneath the tentorium, perforates the dura mater, and rests on the petrous bone, in its course to the middle fossa of the base of the cranium, where the sensor portion expands into the *Gasserian ganglion.* This ganglion is of a triangular shape, and, when fully exposed, presents a plexiform arrangement, with gray neurine intermixed. It is covered by a lamina of the dura mater, which adheres closely to it. The motor filaments pass over its under surface, and not through it. From its base proceed the ophthalmic and the superior and inferior maxillary branches. The *first* of these passes through the sphenoidal foramen; the *second*, through the foramen rotundum; and the *third*, through the foramen ovale. All the *motor* filaments accompany the inferior maxillary branch. The dura mater obtains filaments from the fifth pair. It will be observed that this nerve resembles the spinal nerves in having a motor and a sensor root, and the sensor portion having a ganglion on it.

The Sixth Pair, or Abducentes, Fig. 17 (33), arise from the corpora pyramidalia, just as they enter the pons. Each nerve passes through the wall of the cavernous sinus and the sphenoidal foramen to reach the external rectus of the eyeball. While passing through the wall of the cavernous

sinus, it is joined by one or two filaments from the sympathetic. They are much smaller than the third pair, but larger than the fourth

The SEVENTH PAIR, Fig. 17 (34), consist each of two nerves, the portio dura, or facial, and the portio mollis, or auditory nerve. The *portio mollis* is the largest of the two, and is situated behind the portio dura. It arises in the floor of the fourth ventricle by the lineæ transversæ, and from gray neurine in the corpus olivare, passes round the restiform body to join the portio dura just below the crus cerebelli.

The *portio dura* arises from the corpus innominatum, near the calamus scriptorius, and passes through the corpus restiforme; it is joined by the auditory nerve, as before mentioned, and both pass outwards to the meatus auditorius internus. The portio mollis goes to the labyrinth of the ear, the portio dura to the muscles of the face, &c.

The EIGHTH PAIR, Fig. 17 (36), consist each of the glosso-pharyngeal, the pneumogastric, and the spinal accessory of Willis. The *glosso-pharyngeal* and *pneumogastric* arise on each side, by quite a number of filaments, in the groove between the olivary and restiform bodies. The former is situated a little above the latter, and is much smaller. Their roots can be traced to gray matter—respiratory ganglion—in the posterior part of the medulla oblongata, and near to the floor of the fourth ventricle, upon which there are three or four small protuberances corresponding to the origin of these nerves. The *spinal accessory* arises from the side of the spinal marrow, between the roots of the cervical nerves, commencing as low down as the fifth or sixth cervical vertebra. The round cord or nerve which is formed by these roots passes upwards behind the ligamentum denticulatum to the cavity of the cranium, entering it through the foramen occipitale, to join the two preceding nerves. It is very frequently connected by filaments to the first and second cervical nerves.

The eighth nerve leaves the cranial cavity through the jugular foramen, being separated from the internal jugular vein by a ligamentous band.

THE NINTH PAIR, or HYPOGLOSSAL, arise by several filaments in the groove between the olivary and pyramidal bodies. Each nerve corresponds in origin to the anterior roots of the

spinal nerves. It passes through the anterior condyloid foramen, and in its cranial course usually consists of two or more fasciculi.

The study of the cerebral nerves is rendered perhaps more complicated to the student on account of each nerve being designated by a particular name. Their origin is necessarily more difficult to learn than that of the spinal nerves; this results from the gray neurine with which they are connected being more scattered about and not so easily located. If we were able to see clearly and distinctly all the gray matter with which the different cerebral nerves are connected in their origin, we should probably observe the same simplicity in its arrangement as in that of the spinal marrow.

The student should endeavor to acquire familiarity with these nerves by studying them according to their functions, and in connection with the parts to which they are distributed. If, for instance, he refers to the nervous endowment of the tongue, he will at once see the *necessity* of this organ being supplied with at least three different kinds of nerves. It contains muscles which must be supplied with a motor nerve; and if these muscles can act independently of the will, as well as under its direction, then they must be supplied with both *voluntary* and *involuntary* motor filaments. Like nearly all other parts of the body, it must have a nerve of *general sensibility*, and, as it is the seat of taste, it must have a nerve of *special sensibility*. He should learn to contemplate other organs and other parts of the body, in regard to their nervous endowment, in the same manner.

The third, fourth, sixth, and ninth nerves may be regarded as being associated with the motor portion of the fifth nerve, as the distribution of all these motor nerves corresponds to that of the sensor portion of the fifth. As the fifth is the nerve of general sensibility to all parts of the face, superficial as well as deep seated, so would it *then* also be the nerve of voluntary motion to all the muscles of the same parts. This would leave only the four nerves of special sensibility and the portio dura, an involuntary motor nerve, to be distributed to the head; the pneumogastric and spinal accessory going to supply other parts. The following table will exhibit to the student, at a glance, the functional divisions of the cerebral nerves:—

SPECIAL SENSATION . . .	1st. Olfactory. 2d. Optic. 7th. Auditory. 8th. Gustatory.
COMMON SENSATION . . .	5th. Trigeminal. 8th. Pneumogastric.
VOLUNTARY MOTION . . .	3d. Oculo-motor. 4th. Pathetic. 5th. Trigeminal. 6th. Abducens 9th. Hypoglossal.
INVOLUNTARY MOTION . .	7th. Facial. 8th. Spinal accessory.

ARTERIES OF THE BRAIN.

The arteries of the brain are derived from the internal carotid and the vertebral. Each internal carotid gives off at the base of the brain the anterior and middle cerebral, and the posterior communicating branch.

The ANTERIOR CEREBRAL ARTERY, Fig. 18 (13), is directed forwards and inwards to the fissure in front of the chiasm of the optic nerves. Just before it enters the fissure which separates the anterior lobes of the cerebrum, it is connected to the anterior cerebral artery of the opposite side by a transverse anastomosing branch named the *Anterior Communicating Artery*, Fig. 18 (14). This artery is usually not more than one or two lines in length. It completes the *circle of Willis* anteriorly. The anterior cerebral arteries then enter the fissure together, and pass upwards over the anterior extremity of the corpus callosum, and backwards on its superior surface to its posterior extremity. They are sometimes called the *arteries of the corpus callosum*, where they rest on that body.

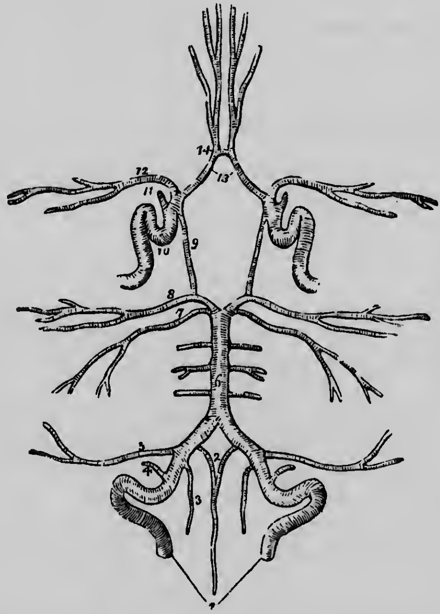
The MIDDLE CEREBRAL ARTERY, Fig. 18 (12), passes outwards and backwards to the fissure of Sylvius, in which it gives off a great number of branches. To trace this artery in its course, the anterior lobe must be separated from the middle, so as to expose the whole of the fissure of Sylvius.

The POSTERIOR COMMUNICATING ARTERY, Fig. 18 (9), passes

backwards to join the posterior cerebral artery, which is a branch of the vertebral. It varies greatly in size.

The VERTEBRAL ARTERIES, Fig. 18 (1), enter the cavity of the cranium through the foramen occipitale, and coalesce just

Fig. 18.



1. The vertebral arteries. 2. The two anterior spinal branches. 3. One of the posterior spinal arteries. 4. The posterior meningeal artery. 5. The inferior cerebellar. 6. The basilar artery. 7. The superior cerebellar. 8. The posterior cerebral. 9. The posterior communicating. 10. The internal carotid. 11. The ophthalmic. 12. The middle cerebral. 13. The anterior cerebral. 14. The anterior communicating.

behind the pons Varolii to form the BASILAR ARTERY, Fig. 18 (6). This artery extends to the anterior border of the pons, where it divides into the posterior cerebral arteries. The cerebellar arteries are given off, the inferior from the vertebral, and the superior from the basilar.

The POSTERIOR CEREBRAL ARTERY, Fig. 18 (8), on each side is directed outwards and backwards round the crus cerebri

to the great transverse fissure, and to the under surface of the posterior lobe of the brain. A short distance from its origin it is joined by the posterior communicating branch of the internal carotid.

The SUPERIOR CEREBELLAR ARTERY, Fig. 18 (7), winds round the crus cerebri to the superior surface of the cerebellum. It is separated from the preceding artery by the third nerve, and accompanies for some distance the fourth nerve. It sends a small branch into the meatus auditorius internus.

The INFERIOR CEREBELLAR ARTERY, Fig. 18 (5), arises from the vertebral, and passes round the medulla oblongata to the under surface of the cerebellum. It passes between the roots of the ninth nerve and in front of the glosso-pharyngeal and pneumogastric.

It will be observed that a free anastomosis exists between the arteries at the base of the brain. The internal carotids are connected together by the anterior communicating artery, while they are both connected to the basilar by the two posterior communicating arteries. It is by means of these communicating arteries that the *circle of Willis* is formed. It will also be noticed that no arterial branch of any considerable size penetrates the substance of the brain.

The following parts are to be examined in the base of the cranium after the brain has been removed.

The DURA MATER.—This membrane will be found to adhere very closely to the greater part of the base of the cranium. It sends out prolongations through the various apertures to be continuous with the periosteum, and to form sheaths for the nerves. It is firmly attached to the margin of the foramen occipitale, but does not adhere to the walls of the spinal canal. Its internal surface is everywhere lined by the arachnoid. The falx cerebri was examined before the removal of the brain, and the tentorium was necessarily cut in that operation. The student can, however, replace it, and retain it *in situ* with a few stitches, so as to get a very good view of it and its connections.

The TENTORIUM, Fig. 9 (8), forms a horizontal septum between the spaces occupied by the cerebellum and posterior lobes of the cerebrum. Its convex border corresponds to the transverse ridge on the inner surface of the occipital bone, extending

forwards to the base of the petrous portion of the temporal bone. Anteriorly it is attached to the petrous bone, and to the clinoid processes of the sphenoid. Its centre is somewhat raised, so as to form an arch, and has attached to its upper surface in the median line the posterior extremity of the falx cerebri. Its attachments are such that it is kept in a state of tension, and is consequently well adapted to support the posterior lobes of the cerebrum and to protect the cerebellum. A large oval opening exists in it anteriorly, which establishes a communication between the compartment of the cerebrum and that of the cerebellum and the spinal canal.

The FALX CEREBELLI is a process of the dura mater, which projects into the fissure between the hemispheres of the cerebellum. Its upper and broadest extremity is attached to the under surface of the tentorium; its lower extremity divides into two slips to embrace the foramen occipitale. Its posterior border is attached to the lower part of the vertical ridge of the occipital bone.

The SINUSES, Fig. 8 and Fig. 19, of the dura mater are canals for the transmission of venous blood. They are veins which derive the fibrous layer of their coats from the dura mater; in form they differ from veins in other parts of the body, but not in structure. They have no true valves. Some of the small ones vary in number, but there are usually fourteen or fifteen altogether. Some of these are single and found in the median line, and some exist in pairs.

The *superior longitudinal sinus* has already been described; also the *inferior longitudinal sinus.*

The STRAIGHT SINUS is situated between the laminæ of the dura mater at the junction of the falx cerebri and tentorium. It is formed principally by the venæ Galeni and inferior longitudinal sinus, and terminates in the torcular Herophili, sometimes by two orifices.

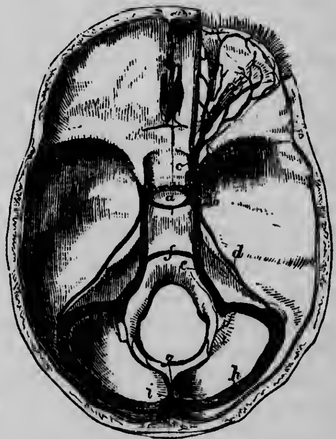
The OCCIPITAL SINUS is in the attached border of the falx cerebelli. Sometimes there are two of them. It collects the blood from the contiguous parts, and conveys it into the torcular.

The LATERAL SINUSES commence at the torcular Herophili and extend to the jugular foramina, occupying a groove on each side in the occipital, parietal, and temporal bones. The

right one is usually larger than the left. They are situated, in the horizontal part of their course, along the convex or attached border of the tentorium. They are the largest of all the sinuses in the dura mater, as they receive the blood from all the rest, to empty it into the internal jugular veins. They increase in size as they proceed towards the jugular foramina, to receive the contents of the petrosal sinuses, the mastoid, and also the inferior cerebral and cerebellar veins. The inferior or curved portion of each is deeply imbedded in the bone, and when cut across presents an oval figure, while the horizontal portion projects between two layers of the tentorium, and is of a triangular shape.

The CAVERNOUS SINUSES are situated one on each side of the sella turcica. They are of an irregular shape, and have a reticulated structure internally. Each receives the ophthalmic vein of the corresponding side. The third and fourth nerves, and the ophthalmic branch of the fifth, pass through its outer wall; the internal carotid artery, and the sixth nerve, pass between its fibrous covering and the serous membrane which lines it. The two cavernous sinuses are connected by the circular sinus. The petrosal sinuses establish a communication between them and the lateral sinuses.

Fig. 19.



a. The circular sinus. *b.* The cavernous sinus. *c.* The ophthalmic vein. *d.* The superior petrosal sinus. *e.* The inferior petrosal sinus. *f.* The transverse sinus. *g.* The occipital sinus. *h.* The lateral sinus on the right side. *i.* The torcular Herophili.

The CIRCULAR SINUS surrounds the pituitary gland, from which it receives several small veins.

The TRANSVERSE SINUS lies across the cuneiform process of the occipital bone. Sometimes there are two of them.

The SUPERIOR PETROSAL SINUS occupies a groove on the upper part of the petrous portion of the temporal bone.

The INFERIOR PETROSAL SINUS of each side is lodged in a

groove along the suture, between the petrous and occipital bones.

It will be observed that the sinuses at the base of the cranium communicate freely with each other, so as to form a sort of venous network.

ARTERIES OF THE DURA MATER.

The arteries of the dura mater are derived from several sources.

The ANTERIOR MENINGEAL are branches of the ethmoidal, and enter the cavity of the cranium through the ethmoidal foramina.

The MIDDLE MENINGEAL is the largest of all the arteries of the dura mater. It passes through the foramen spinosum of the great wing of the sphenoid bone. Its terminal branches were seen when the calvaria was removed. It ramifies between the bone and the dura mater, presenting an arborescent appearance. The grooves or furrows in the bone, which are occupied by the branches of this artery, vary very much in depth. In trephining, the relations of the middle meningeal artery to the osseous walls of the cranium are important to be recollected. The situation of the principal trunk is indicated externally by a line extending from near the centre of the zygoma directly upwards.

The POSTERIOR MENINGEAL ARTERY is a branch of the vertebral. It arises nearly opposite the foramen magnum.

Besides these, the dura mater gets a branch from the internal maxillary, through the foramen ovale, which is sometimes called the *meningea parva;* another branch from the ascending pharyngeal, through the foramen lacerum medius; one from the internal carotid; and a fourth from the occipital, through the foramen lacerum posterius.

The nerves of the dura mater are derived principally from the fifth pair.

SECT. VI.—DISSECTION OF THE APPENDAGES OF THE EYE WITHIN THE ORBIT.

To dissect the appendages of the eye within the orbit, the orbital plate of the frontal bone must first be cut away. This can easily be done, after the calvaria has been removed, with a small sharp chisel or saw. The former is preferable, because it can be accommodated to the inequalities of the surface which is to be cut. The lesser wing of the sphenoid may also be removed with the orbital plate, care being taken not to destroy the optic foramen, nor disturb the contents of the sphenoidal fissure. Before removing the orbital ridge, the tendinous loop for the passage of the tendon of the superior oblique muscle should be examined, or the inner extremity of the ridge to which the loop is attached may be left. In removing the orbital plate, the periosteum which covers its under surface, and to which it is loosely connected, should be preserved.

Before proceeding to examine the contents of the orbit, the student will do well to obtain some idea of what they consist, and in what part of the orbit each is to be found. The dissection must also be conducted slowly and cautiously, so as not to destroy any of the minuter structures involved. The upper plane of the orbit is occupied on the nasal side by the superior oblique muscle, with the pathetic nerve resting on it; in the central portion by the frontal nerve, and immediately below it, the levator palpebræ superioris; and in the outer part by the lachrymal nerve, and beneath it the upper margin of the external rectus, on the outer side of which lies the lachrymal gland.

The FRONTAL NERVE, Fig. 20, enters the orbit above the muscles, and proceeds along its central portion, close to the periosteum, towards the supra-orbital foramen, where it divides into the supra-orbital and frontal branches. The former sends filaments to the upper eyelid, and then passes through the supra-orbital foramen to the forehead; the latter gives off filaments to the eyelid, also one to the frontal sinus, and one which anastomoses with the external nasal; its terminal branches are distributed on the forehead.

The LEVATOR PALPEBRÆ MUSCLE, Fig. 23 (4), *arises* from the roof of the orbit in front of the optic foramen. It widens as it extends forwards, and is *inserted* by a broad tendon into the upper margin of the superior tarsal cartilage.

Fig. 20.

THE NERVES IN THE ORBIT ABOVE THE MUSCLES, BROUGHT INTO VIEW BY REMOVING THE ROOF OF THE ORBIT AND THE PERIOSTEUM.—1. Fifth nerve. 2. Ophthalmic branch of same nerve. 3. Third nerve. 4. Fourth nerve. 5. Optic nerve. 6. Sixth nerve. *a*. Internal carotid artery.

The SUPERIOR OBLIQUE MUSCLE, Fig. 23 (5), *arises* from the inner part of the optic foramen, passes along the inner and upper part of the orbit to the cartilaginous pulley, through which its tendon passes to be reflected downwards, backwards, and outwards to the ball of the eye. The reflected portion of this muscle must be left for the present.

The FOURTH NERVE, or the PATHETIC, Fig. 20 (4), enters the orbit above, and on the inner side of the frontal, which it leaves in the posterior part of the orbit, passing inwards to the superior oblique muscle, which it penetrates by several filaments on the orbital side.

The LACHRYMAL NERVE, Fig. 37 (10), enters the orbit a little to the outside of, and below the frontal nerve, and above the muscles, runs along the upper border of the external rectus to the lachrymal gland, to which it sends filaments; after perforating or passing beneath the gland, it divides into palpebral branches. One of these anastomoses with a branch of the facial, one goes to the integument upon the forehead, and one or two filaments pass downwards to join the second division of the fifth pair.

These parts may now be divided in the anterior portion of the orbit, and reflected back. As the levator palpebræ is turned back, a branch of the third nerve, or motor oculi, will be seen entering it on its under surface. The nerves above described should all be preserved for the purpose of tracing them through the cavernous sinus.

The SUPERIOR RECTUS MUSCLE, Fig. 23 (9), is now seen in the central part of the orbit. It *arises* from the upper and outer part of the optic foramen, and passes forwards to be *inserted* into the sclerotic coat of the eyeball, near its junction with the cornea. This is to be divided near its insertion, and turned back, observing at the same time the branch of the motor oculi nerve, which penetrates its under surface. Beneath the superior rectus, and between the external and internal recti muscles, is the most intricate part of the anatomy of the orbit. The areolar and adipose tissue found here must be gradually and cautiously removed.

The NASAL NERVE, Fig. 21, with the ophthalmic artery and vein, crosses the optic nerve from without inwards. As this nerve enters the orbit between the two heads of the rectus externus, it usually sends a small twig to the lenticular ganglion, and just as it passes over the optic nerve, gives off three or four ciliary branches, which accompany that nerve on its inner side to perforate the sclerotic coat. The nasal nerve then continues its course to the inner part of the orbit, and forwards as far as the anterior ethmoidal foramen, where it divides into an external and internal nasal branch. The *internal nasal* passes through this foramen, and after running a short distance on the cribriform plate of the ethmoid bone, enters the nose through a small foramen at the side of the crista galli, then continues in a groove on the inner surface of the nasal bone to its lower border, where it leaves the nasal cavity

Fig. 21.

THE DEEP NERVES OF THE ORBIT SEEN FROM ABOVE BY REMOVING THE BONE AND DIVIDING THE ELEVATOR OF THE UPPER EYELID AND THE UPPER RECTUS MUSCLE. —*a.* Internal pterygoid muscle. *b.* Temporal muscle. *c.* Cut surface of bone. *d.* Elevator of the eyelid and upper rectus muscle. *e.* Carotid artery. 1. Optic nerve. 2. Fifth nerve. 3. Ophthalmic nerve. 4. Third nerve. 5. Sixth nerve.

to be distributed to the integument covering the ala of the nose.

The *external nasal*, or *infra-trochlear*, goes to the anterior and inner part of the orbit, beneath the tendon of the superior oblique, where it divides into filaments to supply the integument of the upper part and side of the nose, the upper eyelid, and lachrymal sac.

The Lenticular Ganglion, Fig. 22 (s), is a small reddish body, situated between the optic nerve and external rectus muscle, about half an inch behind the ball of the eye. Its size and shape vary in different subjects. Behind, it receives a filament from the nasal and the lower division of the motor oculi, and is usually connected with the sympathetic by a branch from the cavernous sinus. Anteriorly it sends off eight or ten *ciliary branches*, which pass along the outer and under part of the optic nerve to perforate the sclerotic coat. This small ganglion may readily be found by tracing one of the ciliary nerves backwards to its origin.

The Ophthalmic Artery, a branch of the internal carotid, arises near the anterior clinoid process, and enters the orbit through the optic foramen, behind and exterior to the optic nerve, and crosses it to reach the nasal nerve, which it accompanies to the inner and anterior part of the orbit, where it divides into its terminating branches. The following are branches of this artery:—

The *lachrymal branch* arises between the superior and external recti muscles, but soon joins the lachrymal nerve, and accompanies it to the lachrymal gland, which it supplies. It also sends branches to the upper eyelid, to the conjunctiva, and one which perforates the malar bone to anastomose with the deep temporal arteries. It sometimes anastomoses with the middle meningeal.

The *central artery* of the retina penetrates the optic nerve about half an inch behind the eyeball, which it enters through the porus opticus, to be distributed to the retina and hyaloid membrane (Fig. 21).

The *supra-orbital* arises beneath the superior rectus, and passes upwards and forwards on the inner side of this muscle and the levator palpebræ, joins the supra-orbital nerve, and, with it, goes to the forehead, sending a small branch to the frontal bone.

The *ciliary arteries* consist of three sets; the anterior, which are irregular in their origin, perforate the sclerotic coat about two lines behind the margin of the cornea; the long and

Fig. 22.

A View of the Third, Fourth, and Sixth Pairs of Nerves.—1. Ball of the eye, the rectus externus muscle being cut and hanging down from its origin. 2. The superior maxilla. 3. The third pair, or motor oculi, distributed to all the muscles of the eye except the superior oblique and external rectus. 4. The fourth pair, or pathetic, going to the superior oblique muscle. 5. One of the branches of the fifth. 6. The sixth pair, or motor externus, distributed to the external rectus muscle. 7. Spheno-palatine ganglion and branches. 8. Ciliary nerves from the lenticular ganglion, the short root of which is seen to connect it with the third pair.

short posterior arise a little distance behind the ball of the eye; the short, ten or fifteen in number, accompany the ciliary nerves; the two long ones perforate the sclerotic coat, one on either side of the optic nerve, and a little farther from it than the short.

The *muscular branches* are divided into the superior, which go to the superior rectus, oblique, and levator palpebræ; and the inferior, which are distributed to the other recti muscles, and inferior oblique, and from which are derived some of the anterior ciliary arteries.

The *ethmoidal branches* pass through the anterior and posterior ethmoidal foramina, and give branches to the dura mater and upper part of the nasal fossæ.

There are two *palpebral branches;* the superior, which enters the upper lid near the inner angle and anastomoses with the

lachrymal; the inferior, which descends behind the tendon of the orbicularis to the lower lid, and anastomoses with the infra-orbital.

The *nasal artery* runs over the tendon of the orbicularis to the integument covering the side of the nose, and anastomoses with the facial. The frontal goes to the muscles and integument of the forehead.

The Optic Nerve enters the orbit through the optic foramen, and proceeds to the ball of the eye, which it enters just inside of its axis. As it passes through the optic foramen, it receives an investment from the dura mater, which leaves it again to become continuous with the sclerotic coat.

The Ophthalmic Vein, Fig. 19, *c*, is formed by branches corresponding to the arteries in the orbit. It leaves the orbit between the two heads of the rectus externus, passing through the sphenoidal fissure to terminate in the cavernous sinus. At the inner and anterior part of the orbit, it communicates with the frontal and facial veins.

The vessels and nerves which enter the ball of the eye, and which have been examined, may now be detached and turned backwards, to facilitate the dissection of the parts in the lower portion of the orbit.

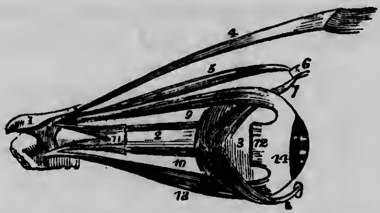
The Internal Rectus Muscle, Fig. 23 (10), *arises* from the margin of the optic foramen, and passes along the inner part of the orbit, to be *inserted* into the sclerotica just behind the cornea. It is partially separated from the eyeball by the inferior oblique. A branch of the motor oculi nerve enters its ocular surface.

The External Rectus, Fig. 23 (11), *arises* by two heads connected by a tendinous arch, beneath which the motor oculi and nasal branch of the fifth enter the orbit. It occupies the outer part of the orbit, and is *inserted* into the sclerotica in the same manner as the other recti. This muscle is supplied by the sixth nerve, or abducens, which enters the orbit between the motor oculi and ophthalmic vein, and penetrates the ocular surface of the muscle by several filaments.

The Inferior Rectus, Fig. 23 (13), *arises* in common with the internal rectus and lower head of the external rectus, and extends along the lower part of the orbit to the eyeball,

into which it is *inserted* like the other recti. It receives a branch from the motor oculi, which enters its ocular surface.

Fig. 23.



A VIEW OF THE MUSCLES OF THE EYEBALL, TAKEN FROM THE OUTER SIDE OF THE RIGHT ORBIT.—1. A small fragment of the sphenoid bone around the entrance of the optic nerve into the orbit. 2. The optic nerve. 3. The globe of the eye. 4. The levator palpebræ muscle. 5. The superior oblique muscle. 6. Its cartilaginous pulley. 7. Its reflected tendon. 8. The inferior oblique muscle; a piece of its bony origin is broken off. 9. The superior rectus muscle. 10. The internal rectus, almost concealed by the optic nerve. 11. Part of the external rectus, showing its two heads. 12. The extremity of the external rectus at its insertion, the intermediate portion of the muscle having been removed. 13. The inferior rectus muscle. 14. The sclerotic coat.

The internal and external recti may now be divided within a short distance of their insertion, and turned back with the nerves supplying them, thus bringing into view the *inferior oblique*, with the nerve distributed to it.

The INFERIOR OBLIQUE MUSCLE, Fig. 23 (8), *arises* from the inner and anterior part of the floor of the orbit, crosses the inferior rectus, between it and the periosteum, and continues in a direction obliquely outwards and upwards, between the external rectus and the eyeball, to be *inserted* into the sclerotica near the insertion of the superior oblique. The nerve to the inferior oblique is the largest branch of the motor oculi; it runs along the exterior border of the inferior rectus, and penetrates the muscle at right angles. This branch of the motor oculi is connected by a filament to the lenticular ganglion.

Besides the nerves already mentioned, a *branch* from the superior maxillary division of the fifth pair enters the orbit through the posterior part of the spheno-maxillary fissure, and divides into the malar and temporal branches. This nerve is situated in the lower and outer part of the orbit. The *malar portion* passes through the malar bone, and supplies,

in part, the orbicularis palpebrarum, anastomosing with the facial nerve. The *temporal portion*, after receiving a branch from the lachrymal nerve, passes through the malar bone to the temporal fossa, in which it ascends some distance, then perforates the temporal aponeurosis, and is distributed to the integument. It anastomoses with the facial in the temporal fossa.

The eyeball may now be removed from the orbit, and the attachment of the ocular muscles to the sclerotic coat examined. For this purpose, the ball should be distended with wax or some other material of sufficient firmness to preserve its shape.

The *insertion* of the oblique muscles should be studied with reference to the axis of the ball, and the manner in which they would affect the eyeball when acting alone or in conjunction with the recti muscles. They would seem to be capable, of resisting the tendency of the recti to sink the eyeball deeper into the orbit, and, at the same time, of steadying it when one or two of the recti act separately, as in turning the eye in a particular direction. They are evidently intended to act in conjunction with the recti, rather than by themselves.

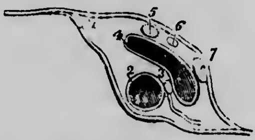
The contents of the sphenoidal fissure, the optic foramen, and cavernous sinus should now be examined. To do this the lesser wing of the sphenoid, with its attachments to the body of the bone, must be removed, if not already done.

The *optic foramen* is occupied by the optic nerve, with the ophthalmic artery, which lies below and outside of the nerve.

The *sphenoidal fissure* has passing through it the ophthalmic vein, the third, fourth, first branch of the fifth, and sixth nerves, and a filament from the lenticular ganglion, to the carotid plexus of the sympathetic. These are arranged as follows: The fourth, the frontal, the superior division of the third and the lachrymal nerves, occupy the upper part of the fissure, and are situated, in relation to each other, as enumerated, beginning with the fourth on the inner side. Immediately below these are the nasal, and the lower division of the third, with the sixth beneath them. The ophthalmic vein or veins, occupy the lowest part of the fissure. The nasal, third, and sixth nerves as they enter the orbit, pass between the two heads of the rectus externus.

The *cavernous sinus*, Fig. 24, contains the same nerves as the sphenoidal fissure, before any division has taken place. They are situated, except the sixth, between the serous and fibrous layers of its upper wall, the third being on the inner side, and the ophthalmic on the outer, with the fourth in the

Fig. 24.



A Transverse Section of the Cavernous Sinus of the Right Side.—1. The dura mater, splitting to inclose the vessels and nerves. 2. The internal carotid artery. 3. The sixth nerve, receiving a branch from the sympathetic. 4. The cavernous sinus. 5. The third nerve. 6. The fourth nerve. 7. The ophthalmic division of the fifth nerve.

middle. Between the laminæ of the lower part of the sinus is the internal carotid artery, with the sixth nerve lying at the outside of it. The sixth nerve is here connected with one or more filaments from the carotid plexus. Filaments may also be traced from this plexus to the other orbital nerves. The intercommunicating filaments which exist between these nerves in the cavernous sinus constitute the *orbital plexus*.

Sect. VII.—The Eyeball.

The eyeball is the special organ of vision. Its internal parts are very delicate and easily destroyed; hence the dissection of it requires careful manipulation. The student should not, however, be discouraged if he fails in his first attempt; a little perseverance will give him the dexterity requisite to expose satisfactorily its minutest parts. The eyes of some of the lower animals may be procured for dissection. These can be obtained in a fresh condition, and, as they are larger, can be dissected with greater facility than the human eye. It will be well to have several on hand at the same time, as the beginner, especially, may expect to destroy quite a number before he succeeds in a complete dissection. Care must be taken that they are not injured in removing them from the orbit.

The muscles, areolar tissue, and mucous membrane should be dissected off from the external surface. This can be done best with scissors.

The eyeball is not a perfect sphere, but seems to consist of segments of two globes of different sizes; the posterior segment forms about four-fifths of the exterior surface of the ball, and the anterior about one-fifth. The antero-posterior diameter of the human eye is about eleven lines, and the transverse about ten.

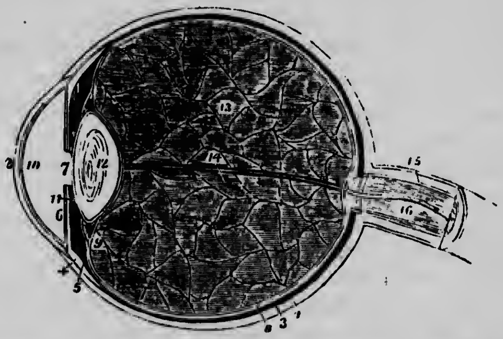
The external tunic constitutes the framework of the eye; gives it form; affords attachments for muscles; allows the passage of rays of light to its interior; transmits vessels and nerves, and serves to protect its internal, delicate structures. This tunic consists of two parts; the *cornea*, which corresponds to the anterior segment, and the *sclerotica*, which corresponds to the posterior segment.

The SCLEROTICA, Fig. 25 (1), is opaque, of a pearly white appearance, and perforated by numerous foramina, which should be observed before commencing the dissection of the ball. Behind, and a little to the inner side of its axis, is the entrance of the optic nerve, which is funnel-shaped from without inwards. This nerve does not pass through a single large opening, but through small apertures, and in separate filaments. The term *lamina cribrosa* has been applied to the structure thus perforated. In the centre of this is the *porus opticus* for the transmission of the *arteria centralis retinæ*, Fig. 28 (2). A short distance from, and around the entrance of the optic nerve are quite a number of small foramina, Fig. 26, for the passage of the ciliary nerves and the posterior long and short ciliary arteries; the long ciliary arteries enter, one on each side of the optic nerve. Just behind the middle of the eye are usually four or five apertures for the exit of the venous trunks formed by the *vasa vorticosa.* Near the anterior margin of the sclerotica are several other small foramina for the transmission of the short anterior ciliary arteries.

As the optic nerve perforates the sclerotica on the internal side of the axis of the eye, it is considerably nearer to the inner than to the outer part of its anterior border. One of the eyes provided for dissection should be divided vertically through its axis, and everything removed but the cornea and sclerotica. The inner surface, the thickness, the structure, and the connection of the sclerotica with the cornea can

now be examined. The inner surface is smooth, being lined with a serous membrane, the *tunica serosa*, and is usually of a

Fig. 25.



A Longitudinal Section of the Globe of the Eye.—1. The sclerotic coat. 2. The cornea. 3. The choroid coat. 4. The ciliary ligament. 5. The ciliary processes. 6. The iris. 7. The pupil. 8. The retina. 9. The canal of Petit, which encircles the lens. 10. The anterior chamber of the eye, containing aqueous humor. 11. The posterior chamber. 12. The lens inclosed in its proper capsule. 13. The vitreous humor inclosed in the hyaloid membrane. 14. A tubular sheath of the hyaloid membrane, or canal of Cloquet. 15. The neurilemma of the optic nerve. 16. The arteria centralis retinæ.

darkish appearance; more so anteriorly, on account of pigmentary cells contained in its structure. It diminishes in thickness from behind forwards to its anterior border. In children of strumous diathesis, the anterior part of it, which is known as the white of the eye, is sometimes so thin and translucent that it presents a bluish tint from the choroid coat showing through it. It is of a dense fibrous structure, consisting of white and yellow elastic tissue; the fibres running in every direction. Its great strength may be tested by an attempt to tear it in any direction. This unyielding character is the cause of great pain in some diseases of the eye.

Its connection with the cornea is very firm, requiring maceration for some time to effect a separation. The margin of the sclerotica is beveled from within outwards, so as to overlap the margin of the cornea, which is beveled in the opposite direction. This overlapping reaches a little further above and below than at either side, thus causing an apparent difference in the transverse and vertical diameters of the cornea. The external surface of the sclerotica is in relation

anteriorly with the conjunctiva, with which it is connected by loose areolar tissue, except near the cornea; just behind this, with the tendons of the muscles of the eye; and more posteriorly, with fat and areolar tissue; its internal surface is in apposition with the choroid coat and ciliary ligament. It is connected by means of the neurilemma of the optic nerve, with the dura mater, and the periosteum of the orbit.

THE CORNEA, Fig. 25 (2), is perfectly smooth and transparent, being adapted to the transmission of rays of light. It consists of the segment of a sphere of about seven lines in diameter.

The two surfaces of the cornea are not exactly parallel, it being thicker in the centre than at the margin; hence it acts to some extent as a lens. It is composed of the four following layers, going from without inwards: The conjunctiva, the proper cornea, the elastic cornea, and the aqueous membrane. The continuation of the *conjunctiva* over the cornea is proved by maceration, by disease, and by the case of animals which shed their skins. This layer is composed of cells which contain a limpid fluid. The *proper cornea* consists of from sixty to seventy lamellæ, connected by a delicate areolar tissue, which contains a vapor or fluid. When the lamellæ are pressed together and this fluid displaced, the cornea is rendered opaque until the pressure is removed, and the fluid restored to its natural condition. The proper cornea is blended with the sclerotica. The *elastic cornea* is a thin, transparent lamina, lining the concave surface of the proper cornea. It is not made opaque by maceration or by boiling; the shape of the cornea is said to depend on it. Its margin projects in between the sclerotica and ciliary ligament. The *aqueous layer* is a portion of the thin delicate membrane, which lines the chambers of the eye, and secretes the aqueous humor.

After death the cornea becomes flaccid on account of the aqueous humor transuding through it. A molecular change in the fluid between the lamellæ of the proper cornea has been supposed to be the cause of the dimness of the eye which occurs in the moribund state. The structure of the proper cornea is regarded as a modified form of white fibrous tissue; that of the elastic cornea is not well understood. The cornea is very sparingly supplied with bloodvessels and nerves; wounds of it, however, generally heal by the first in-

tention. Its liability to disease and injury renders it an object worthy of special attention to the student.

Having examined the outer tunic of the eye, the dissector will proceed to expose the second tunic, which consists of the iris, the ciliary ligament, and the choroid coat. This will require another eye. Holding the eye in one hand, make an incision through the cornea with a sharp scalpel, or puncture it with the scalpel near the centre, and insert the point of one blade of a pair of scissors through the puncture and cut to the margin, taking care to keep the point gently pressed against the inner surface of the cornea, so as not to injure the iris; having reached the edge of the sclerotic coat, the point of the scissors is to be insinuated between it and the ciliary ligament, and then between the sclerotic and choroid coats back to the posterior part of the eye. Success in making this incision depends mainly on keeping the point of the scissors applied to the inner surface of the cornea and sclerotic coat as it glides over the iris, the ciliary ligament, and choroid coat.

Two or three more similar incisions are to be made; then seizing one of the sections of the cornea with the forceps, reflect it back to its connection with the sclerotica, and then, making slight tension, there will be little or no difficulty in separating the sclerotica from the ciliary ligament and choroid coat. The point of a scalpel may be used to facilitate its detachment from the ciliary ligament and divide the vessels which pass through the sclerotica to the choroid coat. When the other sections have been turned back in the same manner, a beautiful view of the iris, ciliary ligament, and choroid coat will be obtained.

As the aqueous humor has escaped, the iris will rest against the lens and ciliary processes, thus obliterating the posterior chamber of the eye. The anterior surface of the iris, with the pupil in its centre, should be observed; also its attachment to the ciliary ligament.

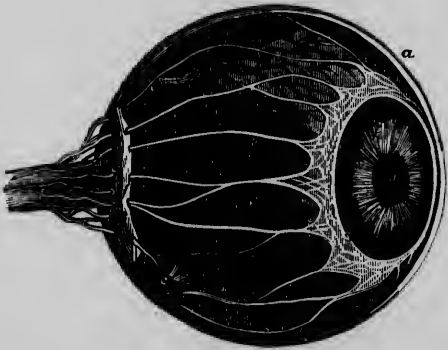
The Ciliary Ligament, Fig. 26, *e*, is about a line in width, of a light color, and attached anteriorly to the iris; posteriorly, to the choroid coat; and by its external surface to the sclerotica. It is composed of fibro-cellular tissue; it is not vascular itself, although it transmits the ciliary arteries to the iris.

The *canal of Fontana* is a groove situated between the cornea, sclerotica, and the ciliary ligament.

Passing over the choroid coat will be seen the *ciliary nerves*, Fig. 26; and the two long *ciliary arteries*, which anastomose around the ciliary ligament with each other and with the anterior ciliary arteries, forming a circle, from which branches are sent into the iris, where another circle is formed. The nerves also penetrate the ligament to reach the iris.

The *veins*, Fig. 26, *c*, in the eye do not accompany the arteries; they are arranged so as to form in the outer layer of the choroid the *vasa vorticosa;* these form four or five princi-

Fig. 26.



Ciliary Nerves.—*a.* Sclerotica. *b.* Vasa vorticosa, and outer surface of choroid. *c.* One of the chief trunks of the vasa vorticosa as they leave the choroid. *d, d.* Ciliary nerves. *e.* Annulus albidus, or ciliary ligament. *f.* Iris. *g.* Pupil.

pal trunks which perforate the sclerotica behind the middle of the eyeball.

The Choroid Coat is perforated behind by the optic nerve. Its external surface presents a smooth, shining appearance, being covered by the inner layer of the *tunica serosa.* Its *color* is a jet black.

Having examined the structures now exposed as far as can be done in the present stage of the dissection, the iris may be divided with the scissors into three sections, and reflected backwards without breaking up its connection with the ciliary ligament.

The boundaries of the *posterior chamber*, Fig. 25 (1 1), of the

eye will now be seen, consisting of the iris in front, and the lens and ciliary processes behind. That a space does actually exist behind the iris, and in front of the lens, which is filled with a portion of the aqueous humor, may be proved by freezing an eye, when a thin layer or pellicle of ice will be found separating these two bodies.

The *anterior chamber*, Fig. 25 (10), of the eye is the space between the concave surface of the cornea and the anterior surface of the iris; it is much larger than the posterior. The iris is the only septum between the two chambers, forming the anterior boundary of one, and the posterior boundary of the other. These chambers communicate with each other through the pupil.

The *pupil*, Fig. 26, *g*, is an aperture in the iris which admits the rays of light into the posterior part of the eye. It is not exactly in the centre of the iris, being placed a little nearer to its inner than to its outer margin. In the human eye it is circular, but in the lower animals varies in shape.

The Iris, Fig. 25, *b*, and Fig. 26, *f*, it will be seen, presents two borders and two surfaces. The *outer* border is attached by areolar tissue to the ciliary ligament, while the *inner* is free; the two surfaces are constantly in contact with the aqueous humor. It is the iris which gives to the eye its color, as we say a person has a 'blue eye,' a 'hazel eye,' or a 'black eye.' Its posterior surface is covered with a dark pigment called the *uvea*, from its resemblance to the color of the grape. Different opinions have been entertained in regard to the structure of the iris. It has been considered by some as composed of an elastic tissue, and by others as consisting of muscular fibres arranged in a circular and radiated form; the *former* consisting of a narrow band around the pupil, and the *latter* extending in a radiated manner to its outer circumference. It is considerably thicker than the choroid coat, and is abundantly supplied with bloodvessels and nerves. It responds to the stimulus of light applied to the retina, regulating by varying the size of the pupil, the number of rays which shall pass through the lens to that tunic. Some persons have the power of exciting its contractility by volition. The size of the pupil may be increased or diminished by medicinal agents, and by certain conditions of the brain, as in concussion and compression.

During the early part of fœtal life, the pupil is occupied by a membrane called the *membrana pupillaris;* this, however, disappears in the human fœtus about the seventh month, but in some of the lower animals continues some days after birth.

The iris should now be detached from the ciliary ligament, and the position of the lens and the ciliary processes surrounding it, carefully noticed. The view presented in this stage of the dissection is important, as the student can now obtain a distinct idea of the relative position of the lens to the anterior border of the sclerotic coat, and be able to understand the connection which exists between it and the framework of the eye, as well as the manner in which, by means of this connection, it is kept in its place.

To separate the choroid coat from the retina, a small opening is to be made through it, near the posterior part of the eye. This may be done by detaching it with the point of the scalpel, being careful not to injure the retina beneath it. When the opening is made, the choroid coat may be easily removed by using two pairs of forceps, cutting away with the scissors, from time to time, portions of it which have been detached. In dissecting off this coat, it may be found convenient to place the eye in a shallow vessel containing water.

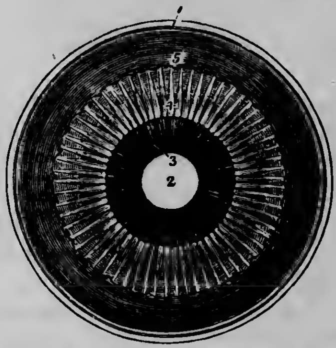
The Choroid Coat, Fig. 26, *b*, is composed of three layers, an external or *venous*, a middle or *arterial* (membrana Ruyschiana), and an internal or *pigmentary layer.* It extends anteriorly to the ciliary ligament and ciliary processes, with which it is intimately connected. Its inner layer consists of six-sided cells, which contain a granular substance. In some animals, the inner surface of the choroid coat presents posteriorly a beautiful metallic lustre, known as the *tapetum.*

As the choroid coat is removed, a layer of areolar tissue may be seen next to the retina; this is the *membrana Jacobi;* by some it is regarded as forming the outer layer of the retina. Sometimes it is with difficulty that this membrane can be exposed so as to allow of its demonstration, even as flocculi floating in water; at other times it may be distinctly seen. As we approach the anterior border of the choroid coat, in the process of removing it, the termination of the nervous layer of the retina anteriorly will be observed; and also, in front of it, the ciliary processes, proceeding to join the hyaloid

processes around the margin of the lens. The view now obtained of the ciliary processes from behind, in connection with the one from the posterior chamber, will afford a very accurate idea of their exact position in the eye. They form a sort of septum between the anterior border of the retina and the posterior chamber, while they establish a connection between the lens and the sclerotic coat through the ciliary ligament on the one hand, and the hyaloid processes on the other.

The CILIARY PROCESSES, Fig. 27 (4), from sixty to seventy in number, are an interesting portion of the mechanism of the eye. The student will do well to study them faithfully; they are, as he will see, directly connected with, or related to, nearly all the other parts of this organ. Externally, they are in relation with the ciliary ligament, the choroid coat and iris; internally, with the hyaloid processes; anteriorly, with the posterior chamber; and posteriorly, with the retina. They are regarded by some as being composed of *muscular tissue*, and capable of acting on the lens through their connection with the hyaloid processes. In this case, their fixed attachment would be to the ciliary ligament, and through it to the sclerotica.

Fig. 27.



THE ANTERIOR SEGMENT OF A TRANSVERSE SECTION OF THE GLOBE OF THE EYE, SEEN FROM WITHIN.—1. The divided edge of the three coats—the sclerotic, choroid, and retina. 2. The pupil. 3. The iris; the surface presented to view in this section being the uvea. 4. The ciliary processes. 5. The anterior border of the retina.

The RETINA, Fig. 25 (8), is composed of three layers: the membrana Jacobi, the nervous, and the vascular layer.

The *membrana Jacobi* is considered by some a serous membrane. It is more intimately connected with the retina than with the choroid coat. It seems to consist of cylindrical cells, varying in length, and arranged vertically or obliquely to the surface of the membrane. To expose it the choroid should be removed from behind.

The *nervous layer* consists of a soft pulpy substance, regarded by some as an expansion of the neurine contained

in the tubes of the optic nerve. It loses its transparency soon after death. In the human eye its anterior border is serrated.

Fig. 28.

THE POSTERIOR SEGMENT OF A TRANSVERSE SECTION OF THE GLOBE OF THE EYE, SEEN FROM WITHIN.—1. The divided edge of the three coats—the membrane covering the whole internal surface is the retina. 2. The entrance of the optic nerve with the arteria centralis retinæ piercing its centre. 3, 3. The ramifications of the arteria centralis. 4. The foramen of Sömmering; the shade from the sides of the section obscures the limbus luteus which surrounds it. 5. A fold of the retina, which generally obscures the foramen of Sömmering after the eye has been opened.

The *vascular* or inner layer is composed principally of a network of vessels proceeding from the central artery of the retina. It is exposed by macerating an eye for two or three days, and then scraping off the nervous layer. It terminates anteriorly by passing in between the ciliary and hyaloid processes. This layer is intended for the ramification of vessels to supply the retina and hyaloid membrane, also to fix and support the nervous layer.

The nervous substance of the retina is deficient in a small spot, about a line from the entrance of the optic nerve and in the axis of the eye; this has been called the *foramen of Sömmering*, Fig. 28 (4). The *limbus luteus* is a yellow spot around this depression or foramen. These points in the retina are best seen when a transverse vertical section of the eyeball has been made. In this section the retina is commonly thrown into folds by being deprived of the support of the vitreous humor.

The HYALOID MEMBRANE, or capsule, contains the *vitreous humor*, Fig. 25 (13), which occupies about three-fourths of the eyeball posteriorly. It is a thin, delicate, transparent membrane, consisting of a general capsule and a large number of septa projecting from its inner surface, so as to form numerous small cells or compartments. These cells communicate with each other, as is shown by the gradual escape of the humor when the vitreous body is cut or punctured. The *hyaloid body*, which includes the hyaloid membrane and the

vitreous humor, is traversed in the centre by a canal, called the *canal of Cloquet*, Fig. 25 (14), for the transmission of a branch of the central artery of the retina. This artery assists in nourishing the hyaloid membrane, and, probably, the lens.

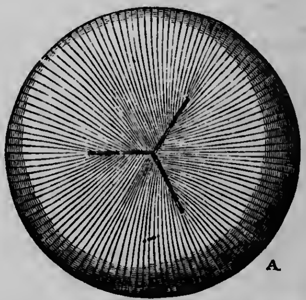
Near the margin of the lens the hyaloid membrane divides into two layers, one of which passes in front, and the other behind it. Between these two layers and the margin of the lens is a series of cells, constituting what has been called the *canal of Petit*, Fig. 25 (9). These cells may be demonstrated by inflating them with a fine blowpipe.

Just behind the canal of Petit, the hyaloid membrane is somewhat thickened, and presents folds or plicæ, named the *hyaloid processes*. These processes are received into grooves between the ciliary processes. When the latter are removed, the former with the pigment adhering to them form the *zonula of Zinn*. The vitreous body is in relation with the retina, the ciliary processes, and the lens, which is partly embedded in it. The vitreous humor is composed of water and about two per cent. of saline substances in solution.

Fig. 29.

A SIDE VIEW OF THE ADULT LENS.—1. Its anterior face. 2. Its posterior face. 3, 3. Its circumference.

Fig. 30.



TRIPLE DIVISION OF THE LENS AND THE COURSE OF ITS FIBRES.

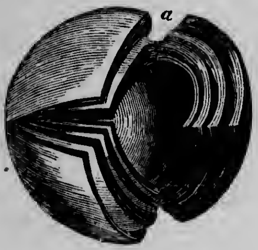
The CRYSTALLINE LENS, Fig, 29, is placed between the vitreous and aqueous humors. Its posterior surface is more convex than the anterior; but, in this respect, it varies in different eyes, and at different periods of life; in the fœtus it is spheroidal, becoming more flattened as age advances.

It has a *capsule* which resembles in structure the elastic

layer of the cornea. This is thicker in front than behind. Its inner surface does not adhere to the lens, which escapes readily when the capsule is divided. Behind, it is connected to the hyaloid membrane by delicate areolar tissue. When it is punctured some time after death, a fluid escapes; this does not probably exist previous to death; it is called the *liquor Morgagni.*

The lens increases in density from the exterior surface towards the centre, which is called the nucleus. Its transverse diameter is about four lines; its antero-posterior about two; its weight is between three and four grains. When boiled in water, or immersed in dilute acid, it separates into concentric lamellæ, and also by slight pressure into three triangular segments, Fig. 31, the bases of which correspond to its circumference. Its minute structure is not well understood. It consists chemically of water, albumen, salts, and an extractive matter.

Fig. 31.



LENS HARDENED IN SPIRIT AND PARTIALLY DIVIDED ALONG THE THREE INTERIOR PLANES, AS WELL AS INTO LAMELLÆ.—Magnified 3¼ diameters.

The *aqueous humor* is contained in the anterior and posterior chambers of the eye. Its weight is about five grains. Its composition is the same as that of the vitreous humor. Both surfaces of the iris are bathed by it.

SECT. VIII.—SPHENO-MAXILLARY REGION.

Before commencing the study of this region, that portion of the cranium which is involved in its dissection should be carefully examined. The following are the parts which require special attention: The ramus of the inferior maxilla with its coronoid and condyloid processes, and the posterior dental foramen; the spheno-maxillary fissure and infra-orbital canal; the pterygo-maxillary fossa, or the space between the pterygoid process of the sphenoid and tuberosity of the superior maxilla, together with the vidian, palatine, spheno-palatine, and round foramina, which open into it; also the foramina ovale and spinosum, which are situated behind the base of the pterygoid process.

The portions of the skull concerned in this dissection may be arranged in three planes: First, the zygoma with the superficial portion of the malar bone. Second, the external portion of the superior maxilla, the glenoid cavity, and eminentia articularis of the temporal bone, and that part of the greater wing of the sphenoid situated in the zygomatic fossa. Third, the tuberosity of the superior maxilla, with the pterygoid process, and the horizontal portion of the great wing of the sphenoid.

The MASSETER muscle, Fig. 61 (16), which was noticed in the superficial dissection of the face, should now be more accurately observed. It is a powerful muscle, consisting of two parts, an external and an internal. The *external* is the largest; it *arises*, chiefly tendinous, from the anterior portion of the zygomatic arch, and the malar process of the superior maxilla, passes downwards and backwards, and is *inserted* into the lower half of the ramus of the inferior maxilla, extending as far back as the angle. The *internal* portion *arises* from the posterior part of the arch; its fibres pass downwards, most of them in a vertical direction, and are *inserted* into the upper half of the ramus of the lower jaw. The lower portion of the internal is overlapped by the fibres of the external. When both masseter muscles act, they approximate the lower jaw to the upper; when the external portions alone act, they move it forwards; and when the internal portions act, they draw it backwards. By acting separately, they can move the jaw laterally. The masseter may now be removed. In doing this, the *masseteric artery* and *nerve* should be sought; the former is a branch of the internal maxillary, and the latter, of the second division of the fifth pair. They penetrate the internal surface of the muscle, just above the sigmoid notch, where they may be easily found.

The masseter having been removed, the zygomatic arch and the contiguous portion of the malar bone may now be cut away, thus exposing the insertion and lower part of the *temporal muscle*, which was described with the soft parts on the outside of the cranium.

The coronoid process should now be cut through, and turned upwards with the temporal muscle, care being taken not to injure the parts beneath. In doing this, the *deep*

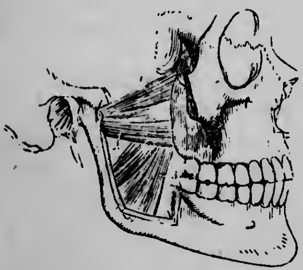
temporal arteries, Fig. 33 (17, 18), and *nerves*, Fig. 37 (22), will be seen penetrating the internal surface of the muscle. Each consists of an anterior and posterior branch, the artery being derived from the internal maxillary, and the nerve from the third division of the fifth pair. A branch of the superior maxillary nerve may also be seen passing through the outer wall of the orbit, and penetrating the muscle in the anterior part of the fossa.

The inferior maxilla should now be divided transversely through the base of the condyloid process, and vertically through the body in a line corresponding to the last molar tooth. In doing this, both the saw and chisel may be advantageously employed. Before cutting through the condyloid process, the masseteric artery and nerve should be traced toward their origin and pushed away.

If the section of bone between the two incisions be carefully turned outwards and backwards, without detaching it from the structures beneath, the following parts will be exposed:—

The PTERYGOIDEUS EXTERNUS, Fig. 32 (1), situated in the upper part of this region, *arises* by two heads, the upper and smaller, from the great wing of the sphenoid, near the root of the pterygoid process, the lower one from the outer plate of the pterygoid process. These two heads pass horizontally outwards, and unite to be *inserted* by a short tendon into the neck of the condyle of the lower jaw, the internal lateral ligament and the interarticular cartilage.

Fig. 32.



THE TWO PTERYGOID MUSCLES. THE ZYGOMATIC ARCH AND THE GREATER PART OF THE RAMUS OF THE LOWER JAW HAVE BEEN REMOVED, IN ORDER TO BRING THESE MUSCLES INTO VIEW.—1. The sphenoid origin of the external pterygoid muscle. 2. Its pterygoid origin. 3. The internal pterygoid muscle.

The *internal maxillary* artery, Fig. 33 (12), crosses over the external surface of this muscle from its lower border near the condyloid process, to the pterygo-maxillary fossa. The masseteric nerve passes over its upper margin from within outwards, and in its course sends a small branch to the temporo-

maxillary articulation. The buccal nerve usually arises by two roots, which unite after perforating the pterygoideus externus; it then runs downwards and forwards over this muscle to the buccinator; at the anterior border of the masseter it becomes superficial, and is distributed to the buccal portion of the face. The posterior deep temporal artery in the first part of its course runs on this muscle; also the buccal artery.

The PTERYGOIDEUS INTERNUS, Fig. 32 (3), is situated deeper and lower down than the externus. It *arises* from the pterygoid fossa, and passes downwards and somewhat backwards, and is *inserted* into the internal surface of the angle and ramus of the lower jaw. In form it resembles the masseter. The pterygoid muscles, when they act on both sides, draw the jaw forwards and upwards; and when they act on one side only, they move the jaw laterally, as in grinding the food.

The *lingual branch*, Fig. 37 (23), of the inferior maxillary nerve will be seen crossing this muscle in a direction from above downwards. The *chorda tympani* joins the lingual at the posterior border of the muscle, having come from the glenoid fissure to this point, along the deep surface of the external pterygoid.

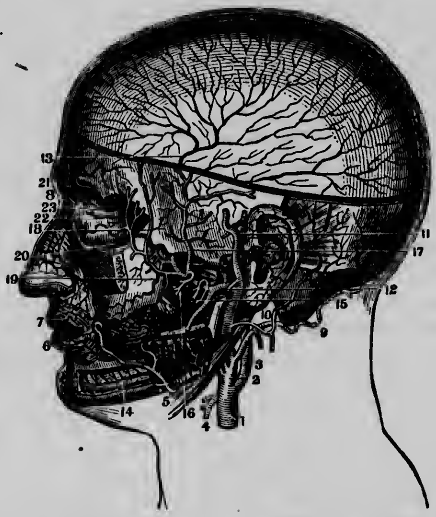
The *mylo-hyoid branch*, Fig. 37 (28), of the inferior dental nerve, with a small artery accompanying it, is situated close to the inner surface of the inferior maxilla, being frequently lodged in a groove in the bone just above the insertion of the pterygoideus internus.

The pterygoideus externus may now be dissected away so as to expose the following branches of the internal maxillary artery, and inferior maxillary nerve, and the posterior dental branch of the superior maxillary nerve. The main trunk of the artery should first be traced to the pterygo-maxillary fossa. The chorda tympani will be seen crossing the artery almost at right angles to join the lingual nerve. The *inferior dental artery*, Fig. 33 (14), and *nerve*, Fig. 37 (24), may be easily found as they enter the posterior dental foramen, and traced from this point to their origin.

The *mylo-hyoid nerve* comes from the dental just before it enters the foramen. The *middle meningeal artery* passes upwards and forwards to the foramen spinosum, through which it enters the cavity of the cranium. It passes between two

roots of the *temporo-auricular nerve*, which passes backwards and upwards between the cervix of the condyle and the auditory meatus, giving off branches to anastomose with the facial, to ascend over the zygoma to the temporal region, to the meatus and tympanum, and also to the articulation and the parotid gland.

Fig. 33.



A View of the Internal Maxillary Artery, as given by Sections of the Bones of the Head and Face.—1. Primitive carotid artery. 2. External carotid. 3. Internal carotid. 4. Section of the superior thyroid artery. 5. Point where the facial artery crosses the lower jaw. 6. Inferior coronary artery. 7. Superior coronary artery. 8. Point of anastomosis of facial with the nasal branch of ophthalmic. 9. The occipital artery. 10. Posterior auricular. 11. Temporal artery. 12. Origin of the internal maxillary artery. 13. Meningea magna of the dura mater ramifying over its surface. 14. Inferior dental artery in the alveolar processes of the lower jaw. 15. The pterygoid arteries. 16. The masseteric arteries. 17. Deep-seated posterior temporal artery. 18. Deep-seated anterior temporal artery. 19. Buccal arteries. 20. Infra-orbital. 21. Posterior palatine. 22. Origin of the pterygoid artery. 23. Origin of the spheno-palatine.

The *tympanic artery* goes through the Glaserian fissure to the tympanum. The *pterygoid branches*, irregular in their origin, penetrate the internal surface of the pterygoid muscles. The *anterior meningeal* artery arises a little in advance of the middle meningeal, and passes through the foramen ovale to the dura mater. The deep temporal, masseteric, and

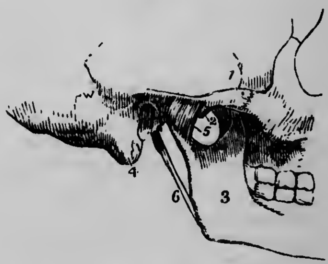
buccal branches have already been seen. The *superior dental* and *infra-orbital* come off just before the main trunk enters the pterygo-maxillary fossa. The superior dental branch penetrates the tuberosity of the superior maxilla to be distributed to the molar and bicuspid teeth. The infra-orbital passes through the posterior part of the spheno-maxillary fissure to enter a canal in the floor of the orbit. The remaining branches of the internal maxillary artery cannot be seen at this stage of the dissection. The *internal maxillary vein* corresponds with the artery and its branches. It communicates with the cavernous sinus and the facial vein. The *posterior superior dental nerve* arises from the superior maxillary in the posterior part of the spheno-maxillary fissure, and runs some distance on the tuberosity of the superior maxilla, which it penetrates to reach the molar teeth.

The TEMPORO-MAXILLARY ARTICULATION should now be examined, so that the structures connected with it may be removed. They consist of an external and an internal lateral ligament, a capsular ligament, an interarticular fibro-cartilage, and two synovial sacs.

The EXTERNAL LATERAL LIGAMENT, Fig. 34 (5), arises from the tubercle of the zygomatic process of the temporal bone, and is inserted into the outer part of the cervix of the condyle of the lower jaw.

The INTERNAL LATERAL LIGAMENT, Fig. 35 (4), arises from the spinous process of the sphenoid bone, passes downwards and forwards to be inserted into the inner border of the posterior dental foramen. It is longer than the external, and is separated from the bone by the internal maxillary artery, and the inferior dental nerve and artery, thus preventing the internal pterygoid muscle from pressing upon them when

Fig. 34.



AN EXTERNAL VIEW OF THE ARTICULATION OF THE LOWER JAW.—1. The zygomatic arch. 2. The tubercle of the zygoma. 3. The ramus of the lower jaw. 4. The mastoid portion of the temporal bone. 5. The external lateral ligament. 6. The stylo-maxillary ligament.

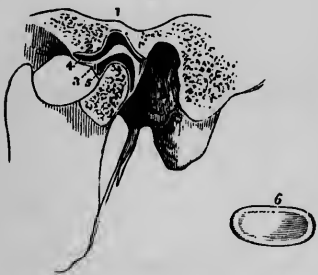
contracting. Some of its fibres which adhere to the capsule have been designated the short internal lateral ligament.

Fig. 35.

An Internal View of the Articulation of the Lower Jaw.—1. A section through the petrous portion of the temporal bone and spinous process of the sphenoid. 2. An internal view of the ramus, and part of the body of the lower jaw. 3. The internal portion of the capsular ligament. 4. The internal lateral ligament. 5. A small interval at its insertion, through which the mylo-hyoid nerve passes. 6. The stylo-maxillary ligament, a process of the deep cervical fascia.

The Capsular Ligament arises principally from the articular eminence and glenoid fissure, and is inserted into the neck of the condyle. It adheres closely to the interarticular fibro-cartilage, and keeps it in place. In front there is a deficiency in it for the insertion of the external pterygoid muscle.

Fig. 36.



In this Sketch a section has been carried through the joint, in order to show the natural position of the interarticular fibro-cartilage, and the manner in which it is adapted to the difference of form of the articulating surfaces. 1. The glenoid fossa. 2. The eminentia articularis. 3. The interarticular fibro-cartilage. 4. The superior synovial cavity. 5. The inferior synovial cavity. 6. An interarticular fibro-cartilage, removed from the joint, in order to show its oval and concave form; it is seen from below.

The Interarticular Fibro-Cartilage, Fig. 36 (3, 6), is placed between the glenoid cavity and the condyle of the jaw, dividing this space into two cavities. It is elongated transversely. Its margins are blended with the ligaments surrounding the joint, and in front with the tendon of the external pterygoid muscle.

There are two Synovial Membranes, Fig. 36 (4, 5), which line respectively the parietes of the two cavities of this joint, the superior being the larger. The interarticular fibro-cartilage is sometimes deficient in the centre, in which case

the two sacs may communicate with each other. This articulation should be studied with reference to luxation, and the action of the masticatory muscles.

The STYLO-MAXILLARY LIGAMENT, Fig. 34 (6), arises from the styloid process, and is inserted into the angle of the lower jaw, furnishing an attachment for a reflection of the deep cervical fascia, and for a part of the stylo-glossus muscle.

The PTERYGO-MAXILLARY LIGAMENT is attached above to the external wing of the pterygoid process, and below to the base of the coronoid process of the lower jaw. The buccinator arises in part from its anterior, and the superior constrictor of the pharynx from its posterior border.

The remaining portion of the malar bone, with the malar process of the maxilla, and that part of the great wing of the sphenoid which forms the posterior boundary of the spheno-maxillary fissure, should now be removed, so as to expose the upper part of the pterygo-maxillary fossa. The infra-orbital nerve and artery may now be traced into and through the infra-orbital canal. The roof of this canal may be best cut away with a small sharp chisel. If the nerve be slightly raised in the canal, the anterior dental branch will be seen leaving it to enter the antrum Highmori. Two or three filaments also leave it to go to the mucous membrane lining the antrum. The infra-orbital nerve, Fig. 37 (7), may now be traced back to the foramen rotundum, in doing which the origin of the posterior dental and orbital branches should be sought. The former consists of two branches, a superior and an inferior; the latter enters the orbit and divides into the malar and temporal branches. The infra-orbital artery has the same course and distribution as the nerve. The infra-orbital vein communicates with the facial by means of the alveolar.

The upper and outer wall of the antrum may now be cut away to follow the dental arteries and nerves in their distribution. To trace these nerves in their minute ramifications, a fresh bone, softened in diluted nitric or muriatic acid, should be used.

The *posterior superior dental nerve*, Fig. 37 (7), enters the upper part of the antrum, and anastomoses with the posterior inferior, and anterior dental nerves.

The *posterior inferior* enters the bone lower down, and divides into filaments which go to the molar and bicuspid teeth.

The *anterior dental nerve*, Fig. 37 (18), which enters from the infra-orbital canal, passes at first horizontally and then downwards in the anterior wall of the antrum; it sends filaments to the cuspid and incisor teeth, and also to the bone, and the lower meatus of the nose.

Fig. 37.

A VIEW OF THE DISTRIBUTION OF THE TRIFACIAL OR 5TH PAIR.—1. Orbit. 2. Antrum of Highmore. 3. Tongue. 4. Lower maxilla. 5. Root of 5th pair, forming the ganglion of Gasserius. 6. 1st branch, ophthalmic. 7. 2d branch, superior maxillary. 8. 3d branch, inferior maxillary. 9. Frontal branch, dividing into supraorbital and frontal at 14. 10. Lachrymal branch, dividing before entering the lachrymal gland. 11. Nasal branch. Just under the figure is the long root of the lenticular or ciliary ganglion, and a few of the ciliary nerves. 12. Internal nasal, disappearing through the anterior ethmoidal foramen. 13. External nasal. 14. Supra orbital and frontal. 15. Infra-orbital nerve. 16. Posterior dental branches. 17. Middle dental branch. 18. Anterior dental nerve. 19. Terminating branches of infra-orbital, called labial and palpebral. 20. Subcutaneus malæ, or orbital branch. 21. Pterygoid or recurrent, from Meckel's ganglion. 22. Five anterior branches of 3d branch of 5th, being nerves of motion, and called masseteric, temporal, pterygoid and buccal. 23. Lingual branch joined at an acute angle by the chorda tympani. 24. Inferior dental nerve terminating in, 25. Mental branchos. 26. Superficial temporal nerve. 27. Auricular branches. 28. Mylo-hyoid branch.

The GANGLION OF MECKEL, or SPHENO-PALATINE GANGLION, may now be examined, with its communicating branches. For this purpose the upper part of the posterior wall of the antrum may be removed, with enough of the great wing of the sphenoid fairly to expose the foramen rotundum. If we now divide the infra-orbital nerve, and turn it backwards, we shall observe two small filaments going downwards to join a small reddish mass, of a somewhat triangular shape, which is the ganglion of Meckel. The following nerves may be discovered proceeding from it in different directions:—

The SPHENO-PALATINE leaves it on the inner side, and passes almost immediately through the spheno-palatine foramen to enter the nose just behind the superior meatus, where it divides into branches which will be described with the nasal cavity.

The PALATINE NERVE, consisting sometimes of two or three divisions, leaves it on the lower side, and enters the palatine canal to divide into an *anterior*, *middle* and *posterior* branch. The anterior is distributed to the roof of the mouth; the middle and posterior to the soft palate, the amygdalæ and uvula. The posterior palatine branch not unfrequently passes through a separate canal in the palatine bone.

The VIDIAN NERVE passes backwards from the ganglion to the vidian or pterygoid canal, and through it into the cavity of the cranium. It sends several small filaments to the sphenoidal sinus. These nerves cannot at present be conveniently followed beyond the pterygo-maxillary fossa. The dissection of this ganglion and its nerves, may be made from the nasal cavity, by breaking away the vertical plate of the palatine bone which forms a septum between the nose and the pterygo-maxillary fossa. If the student wishes, he can dissect one side of the head as above described, and the other side from the nasal cavity.

As much of the great wing of the sphenoid, with the eminentia articularis of the temporal bone must now be cut away as shall be necessary to expose the foramen ovale. Divide the dental and gustatory nerves and turn them up towards the foramen; the otic ganglion will now be observed just below the foramen and on the inner side of the inferior maxillary nerve.

The OTIC GANGLION is a small, reddish body, like the gan-

glion of Meckel. It gives off the following nerves: a fasciculus, which communicates with the inferior maxillary; pterygoid and auricular branches, the latter being a motor and the former a sensor filament; and several filaments, which connect it with the sympathetic, being sent to the plexus on the middle meningeal artery. Two muscular branches also leave this ganglion, one supplying the tensor tympani, and the other the tensor palati. Posteriorly it gives off the *superficial petrosal nerve*, which perforates the petrous bone to join the vidian and a branch from the glosso-pharyngeal in the tympanum. This ganglion, like that of Meckel, may be reached from within by cutting away the levator palati muscle, and finding the cartilaginous portion of the *Eustachian tube*, near the osseous extremity of which it is situated.

Sect. IX.—Dissection of the Ear.

The organ of hearing is divided into the external, middle, and internal portions. The first is covered by the skin, the second is lined by mucous membrane, and the third has no external communication.

The External Ear, Fig. 38, is divided into the *auricle* and *meatus*. The framework of the auricle consists of a fibro-cartilage, which gives to it the peculiar form it presents, and allows of a great degree of flexibility. It is very firmly attached to the margin of the meatus, so much so that the weight of the body may be sustained by the auricles. The following points are to be noticed upon each auricle:—

The cranial surface is, generally convex, while the facial surface is concave. The deepest part, that which leads into the meatus, is called the *concha*. The projection in front of this, and partly covering it, is the *tragus*. When the tragus is pressed inwards, it covers the meatus. Hairs grow from its posterior surface. A little lower down, behind and opposite to the tragus, is the *anti-tragus*. This is smaller than the tragus, and separated from it by a deep notch called the *notch of the concha*, or *incisura tragica*. The *anti-helix* is the ridge which commences just above the anti-tragus, curves upwards and forwards to bifurcate, leaving a depression between its divisions called the *scaphoid fossa*. The external curved border of the ear is the *helix*. The helix is separated

from the anti-helix by the *fossa innominata.* The lower pendulous part of the auricle is the *lobe.* It consists of a duplicature of the skin, with a small portion of adipose substance.

The helix and anti-helix unite behind to form the *processus caudatus*, which is separated from the anti-tragus by a fissure. The *fissure* of the *tragus* is situated on its anterior surface. The *fissure* of the *helix* is just above the tubercle to which is attached the attrahens aurem muscle.

Fig. 38.

A VIEW OF THE LEFT EAR IN ITS NATURAL STATE.—1, 2. The origin and termination of the helix. 3, 3. The anti-helix. 4. The anti-tragus. 5. The tragus. 6. The lobe of the external ear. 7. Points to the scapha, and is on the front and top of the pinna. 8. The concha. 9. The meatus auditorius externus.

The LIGAMENTS of the auricle are intrinsic and extrinsic. The *former* consist of ligamentous bands, intended to preserve the fibro-cartilage in its proper form, and to occupy the fissures. The *latter* consist of, a *posterior*, which connects the concha to the mastoid process; an *anterior*, which extends from the process of the helix to the zygomatic arch; and of a *ligament*, which connects the tragus to the same part.

The INTRINSIC MUSCLES, Fig. 39, of the auricle are the following. The *helicis major* is situated just above the tragus, on the anterior part of the helix. It consists of a narrow band of muscular fibres, tendinous at each extremity.

The *helicis minor* occupies the helix where it projects into the concha.

The *anti-tragicus* extends from the external surface of the anti-tragus to the processus caudatus.

The *tragicus* lies vertically upon the external surface of the tragus.

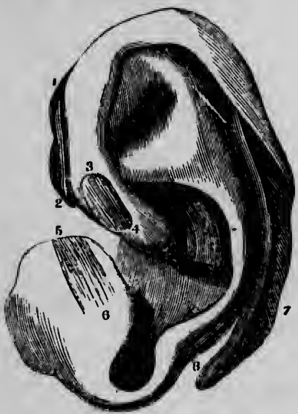
The *transversus auriculæ* is situated on the cranial surface of the auricle, extending from the concha to the helix.

The ARTERIES of the auricle are derived from the posterior auricular, and the auricular branches of the temporal. Quite a large branch from the posterior auricular enters the concha between the anti-helix and the processus caudatus.

The NERVES come from several sources; as the auricularis magnus, the facial, the fifth, and the pneumogastric. The concha is supplied by a branch which perforates the cartilage just above the anti-tragus.

The *meatus auditorius externus*, Fig. 41 (8), is about an inch in length. The inner half of it is osseous, and belongs to the temporal bone. It is slightly curved, with its convexity upwards. Its lower wall is longer than the upper, on account of the oblique position of the membrana tympani. A transverse vertical section of it presents a figure somewhat oval or elliptical, the vertical diameter being the longest. The middle of it is not quite so large as the extremities. The outer portion is partly fibrous and partly cartilaginous. The fibrous structure forms about the upper fourth of the canal. There are two or three fissures in the cartilaginous portion called the *fissures of Santorini*. The structure of this part of the canal admits of some mobility.

Fig. 39.



REPRESENTS THE CARTILAGE OF THE EXTERNAL EAR WITH SOME OF ITS MUSCLES.—1, 2. The helicis major muscle on the front of the helix. 3, 4. The helicis minor muscle. 5, 6. The tragicus muscle on the front surface of the tragus. 7, 8. The anti-tragicus muscle.

The meatus is lined by a reflection of the skin from the auricle. It is very thin and delicate, and covered with fine hairs. In old persons there are usually some quite long stiff hairs near the external orifice, which seem to afford some protection against the entrance of foreign bodies. In the structure of the lining membrane are a number of sebaceous follicles called the *ceruminous glands*. They are of a yellowish color when cut, and secrete an unctuous substance resembling wax. This sometimes accumulates and becomes hard, causing deafness. The meatus should be observed with care by the student. It may be

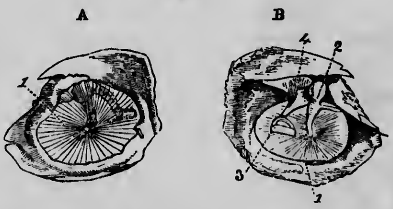
examined by allowing the rays of light to enter in a direction to fall on the membrana tympani, and to expose the whole of the interior surface of the meatus.

THE MIDDLE EAR, OR TYMPANUM.

The tympanum is a small circular cavity, situated between the meatus and the labyrinth, or internal ear. It resembles somewhat a section of the meatus, or it may be regarded as a prolongation of that tube into the base of the petrous portion of the temporal bone, to the extent of about one-fourth of an inch. It is cut off from the meatus by a membrane, which forms its external wall, while the septum between it and the internal ear forms its internal wall. This cavity is about half an inch in diameter, which is rather greater than that of the meatus.

In studying it, three surfaces are presented; its external and internal walls, and its circumference.

Fig. 40.



MEMBRANA TYMPANI FROM THE OUTER (A) AND FROM THE INNER (B) SIDES.—1. membrana tympani. 2. Malleus. 3. Stapes. 4. Incus.

Its external wall is formed by the membrana tympani, and the inner margin of the parietes of the meatus. The *membrana tympani*, Fig. 40, A, B, is inclined inwards in a direction from above downwards, thus increasing the length of the floor of the meatus. It is concave externally, with its corresponding convexity projecting into the tympanum. It has attached to the upper part of its inner surface the handle of the malleus. It is composed of three laminæ. The *outer* one is reflected from the parietes of the meatus, and the *inner* one from the walls of the tympanum; the *middle* one is fibrous, and is fixed to a groove in the circumference of the tympanic orifice of the

meatus. In the fœtus it is attached to an osseous ring, which is distinct from the rest of the petrous bone. It contains some small vessels. The following points are to be noticed on the inner wall:—

The *fenestra ovalis*, Fig. 41 (10), is situated in the upper part, directly opposite the roof of the meatus. Its long diameter is inclined downwards and forwards. The upper border of it is arched, while the lower is nearly straight. It is occupied in the recent subject by the stapes and by a membrane. The *fenestra rotunda* is located in the posterior part of the inner wall, and lower down than the fenestra ovalis. It is situated at the bottom of quite a deep fossa. Between and below these two orifices is seen the *promontory*. Several small grooves are sometimes observed on the promontory for the lodgment of filaments of Jacobson's nerve; instead of grooves, they may exist in the form of canals in the bone. Just in front of, and a little below the anterior extremity of the fenestra ovalis, is the *tympanic orifice* of the canal for the tensor tympani muscle. The *processus cochleariformis* is a projection of the wall of this canal into the tympanum. The *aqueduct of Fallopius* forms a curved ridge just above the fenestra ovalis. Behind the fenestra ovalis, and near the posterior wall, is the *pyramid*, with a small opening upon its apex which is occupied by the stapedius muscle. The *canal* for the transmission of Jacobson's branch of the glosso-pharyngeal nerve enters the tympanum at the lower part of the promontory.

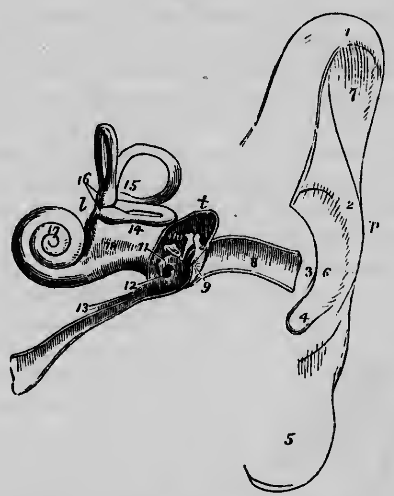
In the posterior part of the tympanum is a large opening which leads into the *mastoid cells*. These cells are lined by mucous membrane, and contain air during life. They are analogous to the frontal and sphenoidal sinuses. Below the mastoid opening is a small foramen, through which passes the chorda tympani nerve, after it leaves the portio dura.

There is nothing in the floor of the tympanum which deserves particular notice. It is quite thin, and is formed by a prolongation inwards of the floor of the meatus. It corresponds to the parotid fossa externally.

In the anterior part of the tympanum is the *fissure of Glaserius*, and the small foramen through which the chorda tympani makes its exit. There is also a small opening for the superficial petrosal branch of Jacobson from the otic ganglion. The tympanic orifice of the Eustachian tube, Fig. 41 (13), occupies the greater part of the anterior wall of

the tympanum. The osseous portion of this tube is separated from the canal for the tensor tympani muscle by the *septum*

Fig. 41.



A Diagram of the Ear.—*p.* The pinna. *t.* The tympanum. *l.* The labyrinth. 1. The upper part of the helix. 2. The anti-helix. 3. The tragus. 4. The anti-tragus. 5. The lobulus. 6. The concha. 7. The upper part of the fossa innominata. 8. The meatus. 9. The membrana tympani, divided by the section. 10. The three little bones, crossing the area of the tympanum, malleus, incus, and stapes; the foot of the stapes blocks up the fenestra ovalis upon the inner wall of the tympanum. 11. The promontory. 12. The fenestra rotunda; the dark opening above the ossicula leads into the mastoid cells. 13. The Eustachian tube; the little canal upon this tube contains the tensor tympani muscle in its passage to the tympanum. 14. The vestibule. 15. The three semicircular canals—horizontal, perpendicular, and oblique. 16. The ampullæ upon the perpendicular and horizontal canals. 17. The cochlea. 18. A depression between the convexities of the two tubuli which communicate with the tympanum and vestibule: the one is the scala tympani, terminating at 12, the other is the scala vestibuli.

cochleariforme. This part of the tube is small in the prepared bone, and much smaller in the recent bone before its membranous lining is removed.

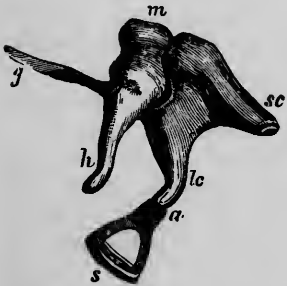
In the upper wall is a depression which is occupied by the head of the malleus and the short leg of the incus. This wall is perforated by several foramina, for the transmission of vessels to the dura mater.

The ossicula auditus, or small bones of the ear, Fig. 42, are the malleus, incus, orbiculare, and stapes.

These form a chain, extending across the tympanum from the membrana tympani to the fenestra ovalis.

The MALLEUS is situated next to the membrana tympani. It consists of a head, neck, handle, and two processes, long and short. The *head* is round and smooth above, and concave below, for articulating with the incus. From the *neck*, which is flattened, the two processes arise; the *short* one is directed to the upper part of the membrana tympani, against which it rests; the *long* one, called the *processus gracilis*, arises from the anterior part of the neck, and projects forwards towards the Glaserian fissure. The laxator tympani muscle is inserted into it. The *handle*, or *manubrium*, has nearly a vertical position, and adheres closely to the fibrous layer of the membrana tympani, the radiating fibres of which diverge from it. It extends to the centre of the membrane, and curves slightly outwards.

Fig. 42.



OSSICLES OF THE LEFT EAR ARTICULATED, AND SEEN FROM THE OUTSIDE AND BELOW.—*m.* Head of the malleus, below which is the constriction, or neck. *g.* Processus gracilis, or long process, at the root of which is the short process. *h.* Manubrium, or handle. *sc.* Short crus; and *lc,* long crus of the incus. The body of this bone is seen articulating with the malleus and its long crus, through the medium of the orbiculare *a,* here partly concealed, with the stapes. *s.* Base of the stapes. Magnified three diameters.

The INCUS is placed on the inner side of the preceding. It presents a body and two processes. There is a concavity on the body for the reception of the head of the malleus. The *short process* is of a conical shape, and directed backwards to the opening into the mastoid cells. Its extremity is attached by a ligament. The *long process* descends a little behind, and nearly parallel to the handle of the malleus, and a short distance from it. Its lower end is curved inwards.

The ORBICULARE is very frequently fixed to the extremity of the long process of the incus. It is round, and flattened like a disk.

The STAPES presents a head, two crura, and a base. Its position is horizontal. The *head* articulates with the orbiculare, and the *base* fits into the fenestra ovalis. The *posterior crus* is longer and more curved than the *anterior*.

These bones are connected to each other by capsular ligaments, which contain synovial membranes. They are also connected to the parietes of the tympanum by three ligaments. The head of the malleus is attached to the roof by a ligament; the short process of the incus is connected to the opening into the mastoid cells, and the base of the stapes to the margin of the fenestra ovalis, by ligamentous fibres.

The muscles of the tympanum are the tensor tympani, the laxator tympani, and the stapedius.

The TENSOR TYMPANI, Fig. 45, *a*, *arises* from the cartilage of the Eustachian tube and the contiguous portion of the sphenoid bone, and also from the bony canal which it occupies just above the septum cochleariforme. It enters the anterior part of the tympanum, and is reflected outwards, to be *inserted* into the handle of the malleus immediately below the processus gracilis.

The LAXATOR TYMPANI is regarded very generally as ligamentous, and not muscular in its structure. It is *attached* to the point of the processus gracilis, and passes through the Glaserian fissure to become *connected* with the internal lateral ligament of the temporo-maxillary articulation.

Another laxator has been described extending from the upper part of the membrana tympani to the malleus.

The STAPEDIUS *arises* from a depression on the pyramid, and passes downwards and forwards to be *inserted* into the neck of the stapes.

The tympanum is lined by a very thin delicate mucous membrane. This adheres closely to the periosteum beneath it. It invests the small bones, and covers the vessels and nerves; is reflected into the mastoid cells, but not into the labyrinth; closes the fenestra rotunda, and the space between the crura of the stapes.

THE INTERNAL EAR, OR LABYRINTH.

The internal ear contains the peripheral expansion of the nerve of hearing. It lies deep in the petrous portion of the temporal bone, and consists of several compartments. From its complex character it has been called the labyrinth. Its compartments are the vestibule, the semicircular canals, three in number, and the cochlea. The vestibule is situated in

the centre, with the cochlea in front and the semicircular canals behind. These osseous cavities contain within them membranous sacs, which constitute the membranous labyrinth. A fluid fills the sacs, and also the osseous cavities outside of the sacs.

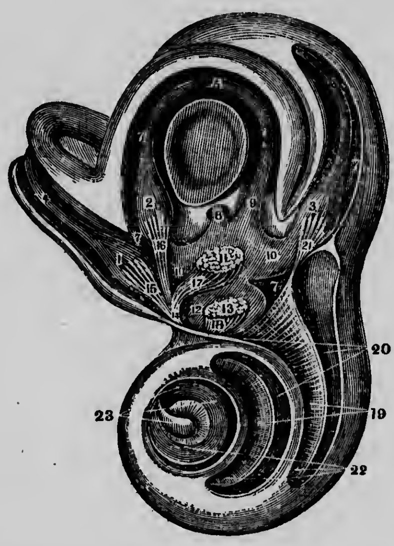
The VESTIBULE, Fig. 41 (14), is placed between the fenestra ovalis on the external side, and the *macula cribrosa* at the bottom of the meatus auditorius internus on the inside. The distance between these two walls is about an eighth of an inch. Its antero-posterior diameter is about one-fifth of an inch. It presents in its circumference three enlargements, called *cornua*, a superior, an anterior inferior, and a posterior inferior. The semicircular canals open by three orifices into the posterior inferior cornu, and by two into the superior, while the vestibular scala opens into the anterior inferior cornu. Thus, it will be seen, that the parietes of the vestibule are perforated by six openings of considerable size. Besides these, there are also small foramina for the transmission of filaments of the auditory nerve, and the aqueduct of the vestibule opening into its posterior part. The vestibule presents two depressions, an inferior, called the *fovea hemispherica*, and a superior, called the *fovea elliptica;* these are separated by a crest named *eminentia pyramidalis.*

The SEMICIRCULAR CANALS, Fig. 41 (15), form each about three-fourths of a circle. They are not exactly round tubes, but compressed slightly on the sides. Two of them open into the vestibule by a common orifice. Dilatations occur at three of their orifices; they are called *ampullæ.* These osseous canals are distinguished from each other by their direction and position. Thus, there is a superior vertical, posterior vertical, and a horizontal one. The *superior vertical* has its convexity upwards; its situation is indicated by a prominence on the petrous bone, which is very distinct in the fœtus; its direction is transversely across the bone. The *posterior vertical* has a direction parallel to the axis of the petrous bone; its convexity looks upwards and outwards. The *horizontal* canal is convex outwards. It is shorter than the other two. The common orifice is formed by the two vertical canals.

The COCHLEA, Fig. 41 (17), resembles in shape the shell of a snail. Its base is situated at the bottom of the meatus auditorius internus, while its apex is directed forwards, outwards,

and downwards. It seems to consist of a tube tapering from one end to the other, and coiled two and a half times round

Fig. 43.



A HIGHLY MAGNIFIED VIEW OF THE EXTERNAL FACE OF THE BONY LABYRINTH OF THE LEFT SIDE, OPENED SO AS TO EXPOSE THE VESTIBULE AND ITS CONTENTS, &C.—The difference of color in the shades of this figure is intended to assist in distinguishing the external from the internal faces of the labyrinth, and also the cavities supposed to be occupied by the liquor of Cotunnius. 1. The ampulla of the superior semicircular canal. 2. The ampulla of the external canal. 3. The ampulla of the inferior canal. 4. The superior membranous semicircular canal. 5. External membranous canal. 6. The inferior membranous canal. 7. The spaces between the bony and membranous semicircular canals, thought to be occupied by the liquor Cotunnii. 8. The common tube formed by the union of the superior and inferior membranous canals. 9. The place where the external semicircular canal opens into the sacculus ellipticus of the vestibule. 10. The sacculus ellipticus containing the otoconia of Breschet, seen at 11. 12. Sacculus sphericus, containing also some otoconia, as seen at 13. 14, 15, 16, 17, 18. The expansions of the auditory nerve to the membranous canals and the sacculus ellipticus, and also to the sphericus. 19. The turns of the lamina spiralis. 20. The scala tympani. 21. The nervous expansion to the posterior ampulla. 22. The scala vestibuli. 23. The modiolus.

a central column. A partition, Fig. 43 (19), passes from the base to the apex in this tube, dividing it into two compartments, called *scalæ*. One of these scalæ opens into the tympanum, and the other into the vestibule, hence they are named the *tympanic* and the *vestibular* scalæ.

The septum between the scalæ is called the *lamina spiralis*; this is partly osseous and partly membranous; it is spoken of as the *lamina spiralis membranacea*, and the *lamina spiralis ossea*. The osseous portion is attached by its inner border to the central column, or *modiolus*, and in the dried preparation looks like the thread of a screw. The upper extremity of this projects slightly from the central column, and forms the *hamulus*. Both it and the outer or membranous portion consist of two lamellæ, between which are placed filaments of the auditory nerve. The osseous lamina is broadest at the base of the cochlea, while the membranous is broadest at the apex. The *modiolus* is a column of a conical shape, with its base perforated by many small foramina, and traversed by several osseous canals for the transmission of the filaments from the internal meatus, which pass through the interior of this tube to get in between the lamellæ of the lamina spiralis. Its apex is somewhat expanded, to which portion of it the term *infundibulum* is applied; this again is covered over by what is called the *cupola*. The modiolus is not a distinct structure, but blended with the inner wall of the tube of the cochlea, and the inner border of the lamina spiralis. The *helicotrema* is a small opening between the scalæ; it is situated immediately beneath the hamulus. This is the only communication between these semicylindrical tubes. The *aqueduct of the cochlea* opens into the scala tympani near the fenestra ovalis.

The different cavities are lined by a very delicate fibro-serous membrane. The fibrous layer adheres closely to the bone, and answers the purpose of a periosteum; the serous layer secretes the *perilymph*, or *liquor Cotunnii*. This lining membrane assists in closing the fenestra rotunda and the fenestra ovalis; it also forms the lamina spiralis membranosa.

The Membranous Labyrinth is found only in the vestibule and semicircular canals. The vestibular portion consists of the *utriculus*, or *common sinus*, and the *sacculus*. It is not certainly ascertained whether these two membranous cavities communicate with each other or not. The utriculus occupies the posterior part of the vestibule, and the sacculus the anterior and inferior parts. The *membranous semicircular canals* correspond with the osseous canals in number, in ampullæ, and in their openings into the utricle. The membranous labyrinth is filled with a semi-fluid called the *endolymph*.

There are observed attached to the utricle and saccule small calcareous bodies, called otolithes, or otoconia.

The *arteries* of the tympanum enter it in the following manner: A small branch from the middle meningeal passes through the hiatus Fallopii; another from the internal maxillary enters it through the Glaserian fissure; a third one comes from the stylo-mastoid, and gets in at the lower end of the aqueduct of Fallopius; it receives branches through the Eustachian tube from the ascending pharyngeal or inferior palatine arteries; the internal carotid also sends a twig into it through a small foramen from the carotid canal.

The *artery* to supply the labyrinth passes through the meatus auditorius internus. It sometimes comes from the superior cerebellar, and sometimes from the basilar. At the bottom of the meatus it divides into a vestibular and a cochlear branch.

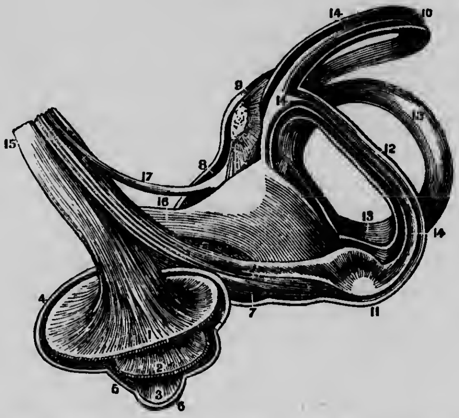
The *nerves* connected with the middle and internal ear are derived from several sources. There are four which enter the petrous bone; one of these terminates in the labyrinth; the other three pass through the bone, traversing in their course the tympanum. The portio dura and portio mollis enter it through the meatus auditorius internus; the former leaves it through the foramen stylo-mastoideum; the latter is distributed to the labyrinth. The vidian enters through the hiatus Fallopii, and makes its exit as the chorda tympani, through a small aperture near the Glaserian fissure. Jacobson's branch of the glosso-pharyngeal passes through a small foramen situated between the jugular fossa and carotid foramen, and leaves the bone as the superficial petrosal branch of Jacobson, just below the hiatus Fallopii to go to the otic ganglion.

The PORTIO MOLLIS, Fig. 44 (15, 16, 17), at the bottom of the meatus divides into two branches, one for the cochlea and one for the vestibule and semicircular canals. The *anterior* or *cochlear division* passes through by a number of filaments the perforated base of the modiolus, and thus enters its osseous canals, from which the filaments enter nearly at right angles the space between the lamellæ of the lamina spiralis, to terminate in a delicate nervous membrane in the form of papillæ.

The *posterior* or *vestibular division* separates into three fasci-

culi; the superior of which enters the vestibule to expand on the utricle and on the ampullæ of the superior vertical and

Fig. 44.



A VIEW OF THE LABYRINTH IN AN INVERTED POSITION, LAID OPEN SO AS TO SHOW THE DISTRIBUTION OF THE NERVES.—1, 2, 3. The cochlea laid open in its fullest extent, so as to show tho lamina spiralis. The figures are placed on the two turns and and a half. 4, 5, 6. The remains of the parietes of the cochlea. 7, 8. The vestibule. 9, 10. Superior canal. 11, 12. Inferior canal. 13. The external canal. 14. The semicircular membranous canals. 15, 16, 17. The auditory nerve in its course to the labyrinth.

horizontal membranous semicircular canals; the middle passes through the macula cribrosa to expand on the saccule; the inferior enters the posterior part of the vestibule to go to the ampulla of the posterior vertical membranous canal.

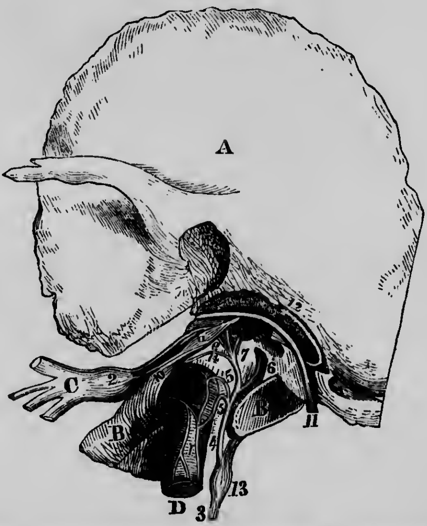
The PORTIO DURA leaves the meatus and enters the aqueduct of Fallopius, passes forwards and outwards to communicate with the hiatus Fallopii, where it is joined by the vidian nerve, and presents a ganglionic enlargement; it then passes backwards and downwards over the fenestra ovalis to reach the foramen stylo-mastoideum. In its course through the tympanum it passes from the upper and anterior part of the inner wall to the lower and inner part of the posterior wall. It is connected by one or two filaments to the portio mollis.

The VIDIAN, after passing through the hiatus Fallopii, joins the portio dura and accompanies it through the tympanum and a short distancc into the stylo-mastoid canal,

then leaves it, returns by a bony canal into the tympanum, and goes forwards between the handle of the malleus and long process of the incus, to a small foramen close by the Glaserian fissure. After leaving the portio dura, it is called the *chorda tympani.*

The NERVE OF JACOBSON, from the glosso-pharyngeal, enters the tympanum just below the promontory, and after giving off the following branches leaves it through an osseous canal in the upper and anterior part near the hiatus Fallopii:

Fig. 45.



A DRAWING OF THE TYMPANIC NERVE FROM BRESCHET'S WORK ON THE EAR.—A. Squamous part of temporal bone. B, B. Petrous portion of same. C. Lower maxillary nerve. D. Internal carotid artery. *a.* Tensor tympani muscle. 1. Carotid plexus. 2. Otic ganglion. 3. Glosso-pharyngeal nerve. 4. Tympanic nerve. 5. Branches to carotid plexus. 6. Branch to fenestra rotunda. 7. Branch to fenestra ovalis. 8. Branch to join the large superficial petrosal nerve. 9. Small superficial petrosal nerve. 10. Nerve to tensor tympani muscle. 11. Facial nerve. 12. Chorda tympani. 13. Petrous ganglion of the glosso-pharyngeal. 14. Branch to the membrane lining the Eustachian tube.

One branch enters the carotid canal to join the sympathetic; another joins the vidian in the hiatus Fallopii; a third goes to the Eustachian tube; a fourth to the fenestra ovalis, and a fifth to the fenestra rotunda. By a division of this nerve into

filaments, and these filaments reuniting, the *tympanic plexus* is formed. Before entering the tympanum, Jacobson's nerve is connected by filaments with the pneumogastric and facial nerves. This nerve joins the superficial petrosal branch of Jacobson, and thus forms a communication between the ganglion of the glosso-pharyngeal and the otic ganglion.

Sect. X.—Dissection of the Nose.

The nose is the organ of smell; it affords to the lungs an external communication which is constantly open for the transmission of air; it furnishes a passage or common outlet to several cavities lined by mucous membrane; it also contributes essentially to the perfection of the voice. It occupies a central position in the facial portion of the head. It has on each side of it the orbit above and the antrum Highmori below, and extends from the floor of the cranial cavity above to the roof of the mouth below. It opens anteriorly upon the face, and posteriorly into the upper part of the pharynx. It is divided into two compartments called the nasal fossæ, which are separated by an osseo-cartilaginous septum.

The term *nose* is more commonly applied to that portion which projects upon the face. The structure of the lower and most prominent portion of this is cartilaginous, while the upper part is osseous. The muscles, vessels, and nerves of the nose have already been described.

The bones are the *nasal* and the *nasal processes* of the superior maxillæ.

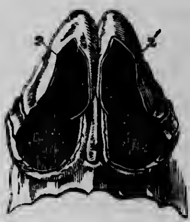
The *cartilages*, or *fibro-cartilages*, form the framework of the movable part of the nose. They furnish a structure of sufficient firmness to preserve the anterior nares patent, while their mobility is a protection against injury, and allows the nostrils to be closed or expanded.

These cartilages consist of the *septal* or *middle*, and *two lateral* upon each side, a *superior* and *inferior*, or *alar*.

The middle cartilage, Fig. 46 (4), forms the anterior septum of the nasal fossæ. The *columna* is the septum between the anterior nares. This cartilage is of an irregular triangular shape; its centre is not so thick as the margins, and is frequently inclined to one side or the other. Its upper and posterior border is attached to the vertical lamella of the

ethmoid, and its posterior inferior border is received between the edges of the vomer and the palatine processes of the superior maxillæ; its anterior border is connected to the nasal suture and to the two inferior lateral cartilages. It sometimes projects backwards between the ethmoidal lamella and the vomer to the rostrum of the sphenoid bone.

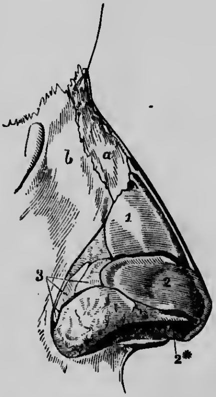
Fig. 46.



View of the Cartilages of the Nose, looking into the Nostrils from below.—2. Outer part of the lower lateral cartilages. 2′. Inner part of the same. 4. Lower edge of the cartilage of the septum.

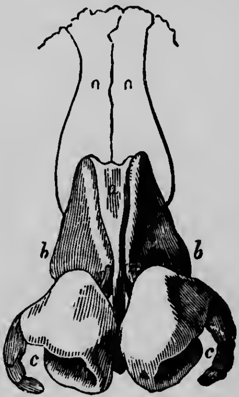
The *superior lateral cartilage*, Fig. 47 (1), on each side is attached above to the lower border of the nasal bone, posteriorly to the nasal process of the superior maxilla, below to the inferior lateral cartilage of the same side, and in the median line to the septal cartilage; the two cartilages are not directly attached to each other at their anterior margins. The anterior margin is thicker than the posterior. They are of a triangular shape. The *inferior lateral* or

Fig. 47.



View of the Bones and Cartilages of the outer Nose, from the Right Side.—*a*. Nasal bone. *b*. Nasal process of upper maxillary bone. 1. Right upper lateral cartilage. 2. Lower lateral cartilage, its outer part. 2*. Inner part of the same. 3. Sesamoid cartilages.

Fig. 48.



Front View of the Cartilages of the Nose. Above is seen the Outline of the Nasal Bones.—*a*. Front edge of the septal cartilage. *b*, *b*. Lateral cartilages. *c*, *c*. Alar cartilages, with their appendages.

alar cartilages, Fig. 48, *c*, *c*, nearly surround the anterior nares; the outer and posterior part of each is narrow, but is enlarged anteriorly to form with its fellow on the opposite side the apex of the nose. Each projects backwards below the septal cartilage to assist in forming the columna. Behind where their outer portions are attached by dense fibrous tissue to the maxilla, are usually on each side two or three small cartilages, called the *sesamoid cartilages*. The inner portion of each alar cartilage is connected behind to the nasal spine. The lower parts of the alæ of the nose are formed by dense areolar tissue.

The NASAL FOSSÆ should be studied in the first place in a prepared skull, which has been divided by a vertical section made a little to one side of the median line, so as to leave the osseous septum entire. A knowledge of the nasal fossæ is too important to be neglected by the student. If he be familiar with the osseous walls of these cavities, he will encounter very little difficulty in dissecting and understanding the soft parts connected with them.

Each nasal fossa is somewhat wedge-shaped; the thin edge looks upwards, and is rounded off anteriorly and posteriorly, to correspond to the arched roof of this cavity.

The *inner* wall, Fig. 49, is formed above by the vertical

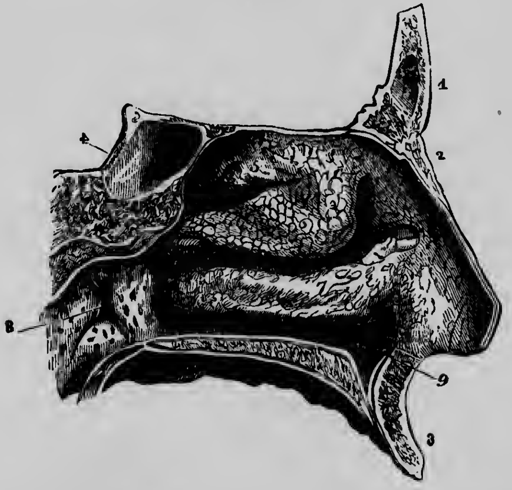
Fig. 49.

OSSEOUS AND CARTILAGINOUS SEPTUM OF THE NOSE, SEEN FROM THE LEFT SIDE.—*a*. Nasal bone. *b*. Superior maxillary bone. *c*. Sphenoidal sinus. *d*. Central or perpendicular plate of the ethmoid bone. *e*. Vomer. 2*. Inner part of the (right) lower lateral cartilage of the nose. 4. Cartilage of the septum.

lamella of the ethmoid bone; below and behind by the vomer; the angular space between these bones anteriorly is occupied by the septal cartilage. The outer wall, Fig. 50, is very uneven on account of the projection of the turbinated bones into the fossa.

The INFERIOR TURBINATED BONE, Fig. 50 (7), is a separate piece. Its inferior free border is situated about half-way between the superior maxilla and the septum nasi, and about four lines from the floor of the fossa. The distance between its central part, which is more prominent than the extremities, and the septum, is usually less than a fourth of an inch. The space below and between this bone and the nasal wall

Fig. 50.



THE OUTER WALL OF THE LEFT NASAL FOSSA COVERED WITH THE PITUITARY MEMBRANE.—1. Frontal bone. 2. Nasal bone. 3. Superior maxillary. 4. Sphenoid. 5. The upper spongy bone. 6. Middle spongy bone. 7. Lower spongy bone. The three meatuses of the nose are seen below the three last-named bones respectively. 8. The opening of the Eustachian tube.

of the antrum is the *inferior meatus;* the ductus ad nasum opens into the anterior extremity of this meatus. The surface of the inferior turbinated bone is very rough, presenting numerous elevations and depressions. Its attachments are slight, consequently it is easily broken away.

The MIDDLE TURBINATED BONE, Fig. 50 (6), is a part of the ethmoid; and is not half as large as the inferior. This is situated in the lower part of the upper half of the nasal fossa; its free border is separated from the inferior about two lines. The *middle meatus* is the space below and on the outside of it. The antrum Highmori, the anterior cells of the ethmoid and the frontal sinus open into this meatus. The frontal sinus is nearly half an inch above and in front of its anterior extremity, and the opening between them is called the *infundibulum.*

The SUPERIOR TURBINATED BONE, Fig. 50 (5), is about half an inch in length; it is separated from the posterior part of the middle turbinated bone by the *superior meatus*, which is a small sulcus, forming a sort of common opening to the posterior cells of the ethmoid. The spheno-palatine foramen is situated just behind this meatus, and the opening from the sphenoidal sinus just behind and above it. Thus it will be seen that the frontal and sphenoidal sinuses, the antrum of the maxilla, the cells of the ethmoid bone and the nasal duct all communicate with the nasal fossa.

A very small portion of the lachrymal bone is seen in the anterior extremity of the middle meatus. This should be noticed, as showing the relation of the lachrymal sac to the nasal fossa. The vertical lamella of the palatine bone forms a portion of the outer wall posteriorly.

The ROOF of each of the nasal fossæ is arched in its antero-posterior direction. It is formed, proceeding from before backwards, by the nasal bones, the floor of the frontal sinus, the cribriform plate of the ethmoid, and the anterior wall of the sphenoidal sinus. The central or horizontal portion is perforated for the olfactory nerve and the internal nasal branch of the ophthalmic; the anterior sloping portion has a groove for the nasal branch just mentioned; the posterior portion, which is nearly vertical, contains the opening from the sphenoidal sinus. The form of the roof may be modified somewhat, according to the development of the frontal and sphenoidal sinuses.

The FLOOR of each fossa is nearly horizontal in the antero-posterior direction, and concave transversely; it is narrowest at its anterior extremity. The central part is formed by the horizontal plate or palatine process of the superior maxilla; anteriorly, by the bony substance just above the alveolar pro-

cess which contains the canine teeth; and behind, by the horizontal plate of the palatine bone. About a fourth of an inch

Fig. 51.

A VERTICAL SECTION OF THE MIDDLE PART OF THE NASAL FOSSÆ, GIVING A POSTERIOR VIEW OF THE ARRANGEMENT OF THE ETHMOIDAL CELLS, &c.—1. Anterior fossa of the cranium. 2. The same covered by the dura mater. 3. The dura mater turned up. 4. The crista galli of the ethmoid bone. 5. Its cribriform plate. 6. Its nasal lamella. 7, 7. The middle spongy bones. 8. The ethmoidal cells. 9. The os planum. 10. Inferior spongy bone. 11. The vomer. 12. Superior maxillary bone. 13. Its union with the ethmoid. 14. Anterior parietes of the antrum Highmorianum, covered by its membrane. 15. Its fibrous layer. 16. Its mucous membrane. 17. Palatine process of the superior maxillary bone. 18. Roof of the mouth covered by the mucous membrane. 19. Section of this membrane. A bristle is seen in the orifice of the antrum Highmorianum.

behind the nasal spine, and close to the septum nasi, is situated the foramen incisivum, or anterior palatine foramen.

The relation of the external orifice of the Eustachian tube, Fig. 50 (s), to the nasal cavity, should be noticed in the prepared skull, but more particularly in the recent subject, with reference to the introduction of an instrument into it through the nasal fossa.

To examine the nasal fossæ in the recent subject, the head must be divided vertically, as was mentioned in connection with the prepared cranium. A fine saw without any back is best for this purpose.

The nasal fossæ are lined by a *mucous membrane*, which is continued into the sphenoidal, frontal, and maxillary sinuses, and ethmoidal cells; it is continuous through the lachrymal passages with the conjunctiva; with the mucous membrane of the pharynx and Eustachian tubes through the posterior nares,

and with the skin through the anterior nares. On the septum and turbinated bones it is soft, thick, and very vascular; in other places it is blended with the periosteum, and might be called a fibro-mucous membrane. At the lower borders of the turbinated bones it forms quite thick folds; and at the inferior orifice of the nasal duct it forms a fold which has been spoken of as a valve. The spheno-palatine, ethmoidal, and anterior palatine foramina are covered over and concealed by it in the fresh preparation. The openings into the different sinuses are considerably diminished in size by it, and the periosteum beneath it. It has a columnar epithelium. In the sinuses, the mucous membrane is thinner, less vascular, and covered by the squamous epithelium. Cilia exist upon its surface, both in the sinuses and nasal fossæ.

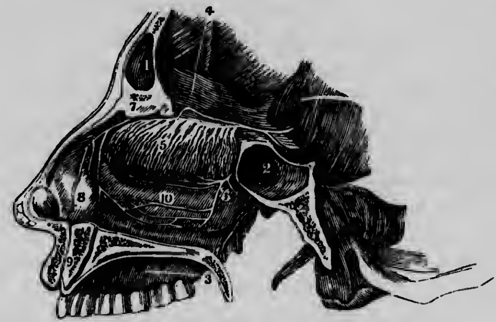
The following *nerves* are found in the nasal fossa. As there are no muscles to be supplied in this cavity, no motor nerves are required.

The OLFACTORY, Fig. 52 (5), enters it from above by numerous filaments, which descend about an inch on the septum, and to the middle meatus on the outer wall. The filaments form minute plexuses beneath the mucous membrane. The exact manner in which they terminate is not known. By tearing off the mucous membrane, the filaments of the olfactory may be traced to their termination in this structure. It will be seen from the distribution of this nerve, that air loaded with odorous particles must reach the upper part of the nasal cavity in order to make an impression on the peripheral expansion of the nerve of smell. The olfactory nerve is spread out upon only a very small portion of the entire surface of the nasal fossa.

The SPHENO-PALATINE NERVE, Fig. 52 (6), consisting usually of several branches, enters the nasal fossa just behind the superior meatus, through the spheno-palatine foramen. Several small branches, called the external, are distributed to the mucous membrane on the outer wall of the fossa, some filaments reaching the septum; a much larger branch, called the *internal* or *naso-palatine*, crosses over to the septum, and descends first vertically, and then horizontally, to reach the anterior palatine foramen, or foramen incisivum, in which it is said to connect with the *ganglion of Cloquet*, Fig. 52 (9); it

then passes through this foramen to the mucous membrane of the hard palate, just behind the incisor teeth.

Fig. 52.



A View of the First Pair or Olfactory Nerves, with the Nasal Branches of the Fifth Pair.—1. Frontal sinus. 2. Sphenoidal sinus. 3. Hard palate. 4. Bulb of the olfactory nerve. 5. Branches of the olfactory nerve on the superior and middle turbinated bones. 6. Spheno-palatine nerves from the second branch of the fifth pair. 7. Internal nasal nerve from the first branch of the fifth. 8. Branches of 7 to the Schneiderian membrane. 9. Ganglion of Cloquet in the foramen incisivum. 10. Anastomosis of the branches of the fifth pair on the inferior turbinated bone.

These nerves ramify between the mucous membrane and periosteum. To obtain a distinct view of them, the part should be kept for some time in dilute nitric acid; when, by separating the membrane from the bone, they can be seen from the fibrous surface.

The *anterior palatine* nerve gives off a branch which enters the nasal fossa near the posterior extremity of the inferior turbinated bone, and ramifies in the lower part of the fossa.

The internal *nasal branch*, Fig. 52 (7), of the ophthalmic, enters the nasal cavity through the anterior part of the ethmoid, near the crista galli, sends some twigs to the septum and outer wall, and then passes down on the inner surface of the nasal bone to its junction with the lateral cartilages of the nose, where it perforates the fibrous structure connecting the cartilage and bone, and is distributed to the integument covering the nose. In its course, some filaments penetrate the bone.

The *arteries* entering the nasal fossa consist of branches from the spheno-palatine, the infra-orbital, the palatine, the

pterygo-palatine, the supra-orbital, the ethmoidal, and the facial. From these various sources the mucous membrane of the nasal fossa is abundantly supplied with arterial blood.

The *veins*, Fig. 8, *k*, correspond with the arteries. Some branches find their way into the frontal sinus, and through the foramen cæcum communicate with the superior longitudinal sinus of the dura mater.

The student should study the nasal fossæ with reference to plugging the nares to arrest hemorrhage; the removal of polypi, and foreign bodies which may happen to be lodged in them; the introduction of instruments to reach the Eustachian tube, or to be conducted into the pharynx through the nasal cavity; their proximity to the brain and its meninges; and their connection with the sphenoidal, frontal, and maxillary sinuses, Fig. 52 (1, 2), and the ductus ad nasum. The exact relation of the osseous sinuses, just mentioned, to the nasal fossæ should be carefully noted; the manner in which a purulent collection in either of these sinuses would be affected, in regard to its escape, by the position of the head.

If, for instance, pus should be formed in the maxillary sinus or antrum, a large proportion of it would necessarily be retained as long as the head was kept in a vertical position, on account of the opening from it into the middle meatus being situated in the upper part of its nasal wall; nor could it be emptied of its contents until the head was placed upon the opposite side. In case of a purulent discharge from the nose, a knowledge of this fact would enable the physician to determine whether it came from the antrum or not.

The contents of the sphenoidal sinus, in case of a purulent collection, would be emptied entirely only when the head was placed with the face looking directly downwards. As the opening from the frontal sinus is in its floor, its contents would escape when the head occupied a vertical position. The nasal orifice of the ductus ad nasum should be observed, and the introduction of a probe of the proper curve into it should be practised upon the subject. The same thing should be done with the antrum and Eustachian tube.

A correct idea of the dimensions of the nasal fossa is exceedingly important. It will be observed that the upper part of it is very narrow, and will not admit an instrument of much size without injuring the parietes.

The *walls* of the antrum, Fig. 51 (14), should be noticed as

regards their thickness, and their relation to the mouth, the nose, the orbit, the pterygo-maxillary fossa, and the face.

The frontal sinus also demands attention, with reference to diagnosis, in diseases and injuries of it, and the proper treatment to be instituted, whether medical or surgical.

Before dissecting the tongue, soft palate, pharynx, and larynx, the student should carefully examine the topography of the mouth, the fauces, and the pharynx. For this purpose, the head must be divided vertically, a little to one side of the median line, so as to avoid injuring the septum of the nose, as before directed, and at the same time leave the uvula entire. The back of the neck should be dissected before this section is made, in order that the upper cervical vertebræ may be divided with the head. It will not be necessary to divide the tongue or the larynx. The pharynx, however, should be opened along the median line posteriorly.

SECT. XI.—TOPOGRAPHY OF THE MOUTH, FAUCES, AND PHARYNX.

The MOUTH is the first division of the alimentary canal. It is exceedingly important, on account of the several functions with which it is associated. The organ of taste is located here; the processes of mastication, insalivation, the articulation of sounds, and the commencement of deglutition, all take place in the cavity of the mouth. It is surrounded by movable walls, except the upper, and consequently is subject to great variation in its dimensions. When the lower jaw is applied to the upper, it is divided into two cavities; the *outer* one is situated between the cheeks and lips, and the teeth and alveolar processes; the *inner* one is embraced within the circumference of the teeth and alveoli. The former receives the saliva secreted by the parotid glands; while that secreted by the submaxillary and sublingual is poured into the latter, thus securing a proper intermixture of the saliva with the food. The *external* orifice of the mouth opens into the one, and the *internal* orifice opens out of the other into the fauces. The food is kept between the teeth until properly masticated, by the action of the lips and cheeks on the outside, and the

tongue on the inside of them. The lips are active agents in receiving food into the mouth, and the tongue is concerned in forcing it back into the pharynx.

Both cavities are lined by mucous membrane, which is worthy of particular attention, as presented on the upper surface of the tongue, on the alveoli and hard palate, and in the other parts of the mouth.

The Lips are composed of the following structures: The orbicularis oris forms the middle and larger portion of their bulk; it is covered on the outside by skin and subcutaneous areolar tissue; and, on the inside, by mucous membrane and submucous areolar tissue. They are abundantly supplied with arteries and nerves. The *labial glands* are situated on their inner side. The lips never contain adipose tissue. Their great size in the African is owing mainly to the size of the orbicular muscle.

The free borders of the lips in a state of health are of a bright red color; but in an anæmic condition of the system, or when the blood recedes from the cutaneous capillaries, they present a pale appearance. The study of the lips is very interesting and important to the artist, as they have so much to do in giving expression to the countenance.

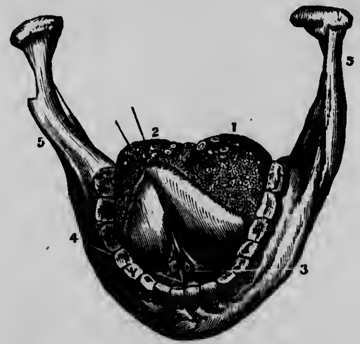
The Cheeks are composed of the same elements as the lips; besides, they usually contain more or less adipose substance. The principal muscle in each cheek is the buccinator. It is perforated opposite the second upper molar tooth by the duct of the parotid. Besides the small buccal glands beneath the mucous membrane, there are two quite large ones situated between the masseter and buccinator muscles; these are called the *molar glands.*

The fulness or plumpness of the cheeks depends partly on the fat which they contain, and partly on the presence of the teeth. The mucous membrane of the lips and cheeks is reflected upon the alveolar processes, where it is blended with the fibrous structure beneath. It is here thick and dense, and possesses very little sensibility, as shown in infants, and in old people who have lost their teeth. It connects on the two sides of the alveolus, between the teeth and over the interalveolar septa. The gums are supplied with mucous follicles. Tartar, as it is called, is a product of these follicles.

The mucous membrane forms a fold on the inner side of each lip, which is called frænum labii.

In the posterior division of the buccal cavity, the mucous membrane and the papillæ of the tongue are the principal things now to be examined. The portion covering the hard palate is similar to that of the gums. It is rough and uneven. Between it and the bone ramify vessels and nerves. It covers over and conceals the anterior and posterior palatine foramina. Between the alveolar processes of the lower jaw and the free border of the tongue it is thin, and loosely connected to the subjacent tissues. In the median line and on the under surface of the tongue it presents a fold, called the *frœnum linguœ*. This is so large and unyielding in some cases, that it interferes with the movements of the tongue. The difficulty is removed by dividing its free border. Just behind the incisor teeth, Fig. 53 (3), the mucous membrane is perforated

Fig. 53.



A VIEW OF THE LOWER JAW, WITH THE TONGUE DRAWN UPWARDS, SO AS TO SHOW ITS UNDER SURFACE IN SITU.—1, 2. The posterior superior surface of the tongue, with the papillæ maximæ. 3. The opening of the duct of the submaxillary gland, or the duct of Wharton. 4. The sublingual gland, seen under the mucous membrane of the mouth. 5. The lower jaw.

by the excretory ducts of the sublingual and submaxillary glands. The upper surface of the tongue is studded with papillæ, Fig. 54, which render it quite rough. There are two kinds of these papillæ. One set is perforated, and the other is not. The former are situated near the base of the

tongue, and are of a glandular structure. They are arranged in two rows. The mucous membrane is not closely adherent to them, as it is to the true papillæ.

Fig. 54.

THE TONGUE, WITH ITS PAPILLÆ.—1. The raphé, which in some tongues bifurcates on the dorsum of the organ, as in the figure. 2, 2. The lobes of the tongue. The rounded eminences on this part of the organ, and near its tip, are the papillæ fungiformes. The smaller papillæ, among which the former are dispersed, are the papillæ conicæ, and filiformes. 3. The tip of the tongue. 4, 4. Its sides, on which are seen the lamellated and fringed papillæ. 5, 5. The V-shaped row of papillæ calyciformes. 6. The foramen cæcum. 7. The mucous glands of the root of the tongue. 8. The epiglottis. 9, 9. The fræna epiglottidis. 10, 10. The greater cornua of the os hyoides.

The true papillæ are divided into three classes, as follows:—

The *calyciform* consist of two rows which are arranged in the form of the letter V. There are from six to eight in each row. They are situated on the posterior part of the tongue. Each papilla is attached to the centre of a cup-like depression by its small extremity, leaving its large extremity free, and on a level with the surface of the tongue. At the junction of the two rows behind is a deep depression, called the "foramen cæcum." It has opening into it several mucous follicles. Sometimes a papilla is found in the place of it.

The *fungiform* are found near the sides and tip of the tongue. They are of a reddish color, and much smaller than the preceding. They are best seen when a sapid substance is applied to the living tongue, as they then become distended.

The *conical papillæ* are diffused over the greater part of the dorsum of the tongue. They are inclined backwards, which becomes very apparent when the tongue is rubbed from behind forwards, especially in some of the lower animals. They are of a whiter color than the others.

The papillæ are very vascular, and are supplied with filaments from the fifth and glosso-pharyngeal nerves.

The FAUCES, Fig. 55, is the space between the mouth and

the pharynx. It is bounded above by the soft palate, on each side by the anterior and posterior half-arches of

Fig. 55.

MEDIAN SECTION OF THE NOSE, MOUTH, PHARYNX, AND LARYNX.—*a.* Septum of the nose; below it is the section of the hard palate. *b.* The tongue. *c.* Section of velum pendulum palati. *d, d.* Lips. *u.* Uvula. *r.* Anterior half-arch or pillar of fauces. *i.* Posterior half-arch. *t.* Tonsil. *p.* Pharynx. *h.* Hyoid bone. *k.* Thyroid cartilage. *n.* Cricoid cartilage. *s.* Epiglottis. *v.* Glottis. 1. Posterior opening of nares. 3. Fauces. 4. Superior opening of larynx. 5. Passage into œsophagus. 6. Mouth of right Eustachian tube.

the palate and the amygdaloid fossa, which contains the tonsil, and below by the base of the tongue. Its parietes are all movable, and contain muscular structure. The *anterior half-arch*, Fig. 55, *r*, on each side is formed by the palato-glossus muscle and the mucous membrane reflected around it. It has nearly a vertical direction transversely. The *posterior half-arch*, Fig. 55, *i*, is formed by the palato-pharyngeus muscle. Its direction is downwards, backwards, and outwards. It projects inwards more than the anterior. Between these half-arches is the *amygdaloid fossa*. It is of a triangular shape with the apex above. The lower part or base of it corresponds very nearly with the angle of the lower jaw. Its

outer wall is formed by the superior constrictor of the pharynx and the pharyngeal aponeurosis, by which the excavation containing the tonsil is separated from the internal carotid artery.

The *tonsil*, Fig. 55, *t*, is composed of a number of follicles collected into a group. Its internal surface is perforated by foramina which communicate with these follicles. A single foramen may open into a cell or cavity with which several follicles communicate. In excising the tonsil when enlarged, there can be no danger of wounding the internal carotid if the incision be not made deeper than on a level with the half-arches. Nor is there any danger of injuring the same artery in opening abscesses of the tonsil if the bistoury be not carried into it too far in a posterior direction, as the artery lies outside and between the tonsil and the vertebræ, on the rectus capitis anticus major. Abscesses of the tonsil almost always open internally on account of the resistance offered by the pharyngeal aponeurosis. Mucus sometimes collects and becomes inspissated in the follicles, and when discharged gives rise to the idea that tuberculous matter has been expectorated. The tonsil is supplied principally by the palatine branches of the pharyngeal arteries. These arteries sometimes attain a considerable size in enlargements of the tonsils, and consequently may give rise to quite a profuse hemorrhage when they are excised.

The Pharynx, Fig. 55, *p*, is the third division of the alimentary canal. It extends from the cuneiform process of the occipital bone to a point opposite the fifth cervical vertebra. It communicates with the tympana, nasal fossæ, mouth, larynx, and œsophagus. Its position and relation to contiguous parts render an accurate knowledge of it exceedingly important. It may be very properly considered as divided into a *nasal*, a *faucial*, and a *laryngeal* section. This division is not based upon its structure, but upon its relations to the parts placed in front of it. Its posterior wall corresponds to the bodies of the superior five cervical vertebræ. This presents nothing which requires to be noticed at the present time. The same is true with the lateral walls, except at the upper part, where the orifices of the Eustachian tubes are found. The pharynx has no anterior wall peculiar to itself, but is intimately associated with the nasal cavities, the fauces, and the larynx.

The *posterior nares* open into its upper part in a vertical direction. They are each about an inch in height, half an inch in breadth, and about three-fourths of an inch from the posterior wall of the pharynx; their surface is smooth, and they are slightly expanded, which facilitates the introduction of a plug, when this becomes necessary to arrest hemorrhage, and at the same time allows the plug to slip back into the pharynx, unless it be retained by the proper means *in sitû*. It will be observed that in plugging the posterior nares, unless the plug be adapted to their shape, the lower part of the orifice may be closed while the upper part will be left open.

The *pharyngeal orifice* of each Eustachian tube will be seen a short distance behind, and to the outside of the nasal orifice. It is on a plane about one-fourth of an inch above the floor of the nasal fossa. It is somewhat expanded in the shape of a funnel, which readily admits a probe, or a tube for injecting the tympanum. Quite a deep sulcus in the upper and outer part of the pharynx should be noticed. It is just behind, and separated from the Eustachian orifice by a ridge.

The SOFT PALATE and the UVULA, Fig. 55, *c*, *u*, projecting from the centre of its free border, may now be examined. It is a muscular organ, firmly attached to the posterior margin of the hard palate, and projecting backwards and downwards into the pharynx; it serves to extend the floor of the nasal fossæ and roof of the mouth in this direction. It diminishes in thickness from before backwards, and assumes an arched form, with the concavity looking downwards and forwards. When elevated, it has a horizontal direction, and its free border is applied to the posterior wall of the pharynx, so as to form a septum between its upper and two lower divisions. The palate is marked on both of its surfaces in the middle by a whitish line or raphé.

The UVULA has a conical shape, varies very much in size, and consists principally of mucous membrane and areolar tissue, with a few longitudinal muscular fibres. It is pendulous, and, when not enlarged, its tip nearly touches the tongue, near the foramen cæcum. Its areolar tissue is liable to be filled with serum in inflammation of the throat, causing it to rest upon the tongue, and thus giving rise to a sense of titillation. Its weight, in these cases, may have a tendency to draw down the soft palate,

At the lower part of the faucial opening in the pharynx, are two fossæ or depressions, situated between the root of the tongue and the epiglottis, and separated from each other by a fold of mucous membrane, called frænum epiglottidis. These fossæ are sometimes quite deep, and allow small bodies to lodge in them, which may give rise to irritation and spasmodic cough.

In the anterior part of the laryngeal portion of the pharynx will be noticed the epiglottis, glottis, greater cornua of the hyoid bone, posterior borders of the alæ of the thyroid cartilage, arytenoid, and cricoid cartilages. The exact location of each of these bodies is deserving of particular notice. They will be considered separately in connection with the larynx. The hyoid bone seems to belong both to the tongue and the larynx. It will be described with the latter.

Before leaving the cavities just described, it would be well for the student to study them carefully in their relations to each other, as in reference to introducing the stomach tube, extracting foreign bodies from the pharynx or œsophagus, carrying an instrument into the larynx, either through the mouth or nose, opening abscesses in the pharynx, removing polypi or tumors about the posterior nares, &c.

SECT. XII.—DISSECTION OF THE PALATE.

The soft palate contains five pairs of muscles. These are exposed, and their arrangement seen by very little dissection, which may be done after the removal of the pharynx.

The *palatine aponeurosis* is a fibrous prolongation from the posterior margin of the hard palate. It diminishes in thickness as it descends towards the free border. It is connected with the tendons of the palatine muscles, and forms a sort of framework for the palate.

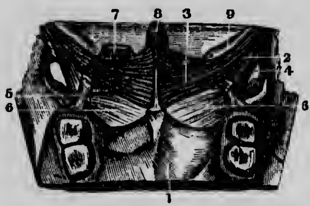
The AZYGOS UVULÆ, Fig. 57 (8), consists of two vertical fasciculi, which *arise* from the centre of the free border of the hard palate, and extend to the tip of the uvula. In excising the uvula, the mucous membrane should not be made tense; if it be done, the fibres of this muscle may project from the wound after the membrane has retracted.

The LEVATOR PALATI, Fig. 56 (2, 3), consists of a vertical

and a horizontal portion. The vertical part is situated behind the Eustachian tube, and outside the corresponding posterior naris. It *arises* from the petrous portion of the temporal bone, near its apex, and from the contiguous part of the Eustachian tube. Its fibres pass downwards, on the outside of the tube, and then turn inwards to be *inserted*, with its fellow, on the opposite side, along the median line of the palate.

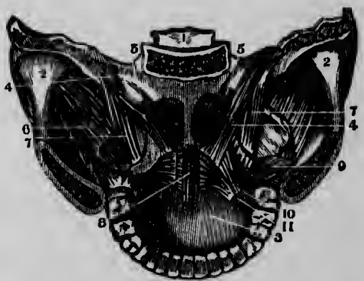
The TENSOR PALATI *arises*, Fig. 56 (4), from the scaphoid fossa at the upper part of the internal pterygoid ala, from a small portion of the great wing of the sphenoid, and from the Eustachian tube. Its fibres pass downwards to the hamular process, where they form a small round tendon, which winds round this process, and is reflected horizontally to the median line of the palate, into which it is *inserted*. Where it plays over the pully-like surface of the hamular process, there is a synovial membrane. Its vertical portion is situated between the internal pterygoid and levator palati muscles.

Fig. 56.



A VIEW OF THE MUSCLES OF THE SOFT PALATE, AS SEEN FROM BELOW AND IN FRONT.—1. The roof of the mouth, or hard palate, sawed across at the second molar tooth. 2. Origin of the levator palati muscle. 3. Its expansion near its insertion. 4. Origin of the circumflexus or tensor palati. 5. The pterygo-maxillary ligament, which converts the notch through which this muscle plays into a foramen. 6, 6. Palatine aponeurosis. 7. A section of the constrictor pharyngis superior muscle. 8. Extremity of the azygos uvulæ muscle. 9. Section of the Eustachian tube.

Fig. 57.



A POSTERIOR VIEW OF THE MUSCLES OF THE SOFT PALATE, AS SHOWN BY A SECTION OF THE CRANIUM THROUGH THE GLENOID CAVITIES.—1. Basilar portion of the sphenoid bone. 2. Condyles of lower jaw. 3. Hard palate. 4. Levator palati, on one side entire, on the other partially removed. 5, 5. Eustachian tubes. 6. External pterygoid muscle. 7. Circumflexus palati. 8. Azygos uvulæ. 9. Myloid attachment of constrictor pharyngis superior. 10. Palato-pharyngeus. 11. Palato-glossus.

The PALATO-GLOSSUS, Fig. 57 (11), is a small, pale fasciculus, which is spread out above in the soft palate and below in

the side of the tongue. Its middle portion forms the anterior half arch of the palate. It is situated immediately beneath the mucous membrane.

The *palato-pharyngeus*, Fig. 57 (10), is described with the muscles of the pharynx.

The *arteries* of the soft palate, or velum palati, are branches of the superior and inferior pharyngeal, and of the internal maxillary.

The *nerves* are derived from the ganglion of Meckel, and from the glosso-pharyngeal.

The *cartilaginous portion of the Eustachian tube* may now be dissected. This tube, altogether, is about two inches in length. It establishes an open communication between the tympanum and pharynx. Its direction being downwards, forwards, and inwards, facilitates the escape of mucus from the tympanic cavity into the pharynx. The cartilaginous portion is about sixteen lines in length. It is much smaller where it unites with the osseous portion of the tube than at its pharyngeal orifice. It is attached to the sides of the groove formed by the petrous and spinous portions of the temporal and sphenoid bones. The outer and anterior part of the tube consists of a fibrous structure. The mucous lining of the tube is quite delicate, except at its orifice, where it resembles that of the pharynx. The position and large size of this opening deserve particular notice, with reference to the introduction of instruments.

Sect. XIII.—Dissection of the Tongue.

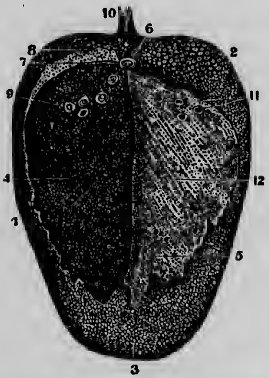
The Tongue is a muscular organ, capable of being moved in different directions, and of varying its form and dimensions. Divided in the median line, it presents two halves in every respect alike. It does not entirely fill the space within the curve of the teeth and alveolar processes. It diminishes in thickness from behind forwards. The anterior part of it is covered wholly by mucous membrane, and not only moves freely in the mouth, but can be protruded from it. The mucous membrane, with the papillæ, were described with the topography of the mouth.

The *framework* of the tongue consists of the hyoid bone, a hard cartilaginous substance situated in the median line,

and a dense fibrous layer beneath the mucous membrane of the dorsum. Fig. 58.

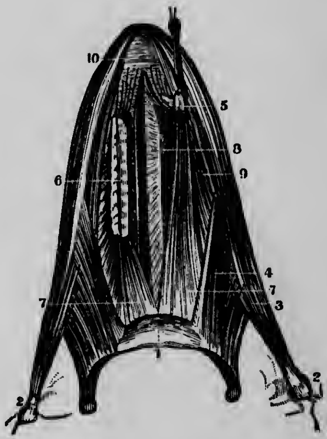
The Intrinsic Muscles of the tongue consist of muscular fibres having a longitudinal, transverse, and vertical direction. The longitudinal fibres are situated near its upper and

Fig. 58.



A View of the Dorsum of the Tongue, from which, by maceration, the Periglottis has been removed, and turned back on the Right Side.—1. The side of the tongue. 2. Its base. 3. Its tip or point. 4. The denuded portion of the tongue, showing the papillæ deprived of the epidermis or periglottis. 5. The under surface of the detached epidermis, showing its depressions. 6. Foramen Cæcum. 7. The truncated papillæ near it. 8. The other papillæ, denuded of the epidermis. 9. Impression of the periglottis around the denuded papillæ. 10. Frænum to the epiglottis cartilage. 11, 12. Depressions on the periglottis which fits the elevations on the tongue.

Fig. 59.



A View of the Muscles of the Tongue, as seen on its Lower Surface.—1. Body of the os hyoides. 2, 2. Styloid processes of the temporal bones. 3. Horizontal portion of the stylo-glossus muscle. 4. The hyo-glossus. 5. The genio-hyo-glossus held up by a hook near its origin. 6. Section of the glossal portion of the same muscle. 7. Its insertion into the os hyoides. 8. The middle fissure and fatty matter between the muscles of each side. 9. The lingualis muscle. 10. The transversales linguæ at the point of the tongue.

lower surfaces, and have been called the superior and inferior lingual muscles. Fig. 59 (9). Their origin and termination are not very distinct. The transverse, Fig. 59 (10), and vertical fibres are seen throughout the substance of the tongue; the former passing from one side to the other, and the latter from the dorsal to the under surface.

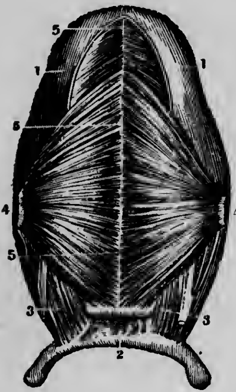
The *extrinsic muscles* are those which have their origin outside of the body the tongue. They are the following:—

The STYLO-GLOSSUS, Fig. 59 (3), *arises* from the styloid process and stylo-maxillary ligament, and, passing downwards, inwards, and forwards, enters the side of the tongue, where it spreads out and divides into an internal and external portion. The latter runs to the apex, while the former takes a transverse direction, and terminates by intermixing with the intrinsic fibres.

The HYO-GLOSSUS, Fig. 59 (4), *arises* from the body and great cornu of the hyoid bone, and enters the tongue between the lingualis and stylo-glossus. The greater part of this muscle is seen in the dissection of the submaxillary region.

The GENIO-HYO-GLOSSUS, Fig. 60 (4), is the largest of the lingual muscles. It *arises* from the lower jaw, near the symphysis. Some of its fibres pass downwards and backwards, and are *inserted* into the hyoid bone. The rest of the fibres, with the exception of a few which spread out upon the side of the pharynx, go to the tongue. They have a vertical direction, and extend the whole length of the tongue near the median line, spreading out in the shape of a fan. At the base of the tongue, the genio-hyo-glossi muscles are separated from each other merely by cellulo-adipose substance.

Fig. 60.



A VIEW OF THE UNDER SURFACE OF THE TONGUE, WITH THE MUSCLES CONNECTED WITH IT.—1, 1. The inferior surface of the tongue. 2. The os hyoides. 3, 3. Origin of the hyo-glossus muscle. 4, 4. The genio-hyo-glossus of each side dissected off and turned to one side. 5, 5. The white central vertical septum of the tongue.

The *palato-glossus* was noticed in the dissection of the palate.

The *arteries* of the tongue are, the lingual and branches of the palatine and pharyngeal. The lingual, in the latter part of its course, is called the *ranine artery*. The *sublingual*, commonly a branch of the lingual, passes between the mylo-hyoideus and genio-hyo-glossus muscles, and sends branches to the sublingual gland and to the frænum linguæ. Branches proceed from the lingual artery to every part of the substance of the tongue.

The *nerves* are supplied from the hypoglossal, glosso-pharyngeal, and the gustatory branch of the fifth. The hypo-

glossal is distributed to the muscles; the glosso-pharyngeal to the mucous membrane at the back part of the tongue; and the gustatory branch of the fifth to the mucous membrane on its sides and tip.

CHAPTER II.

DISSECTION OF THE NECK.

SECT. I.—SUPERFICIAL PARTS OF THE NECK.

THE posterior part of the neck should be dissected with the back, as they have several muscles in common, and also on account of the similarity in the arrangement of their vessels and nerves.

The anterior part of the neck is a very important region, and demands the special attention of the student in the dissecting-room. In it are found the larynx, trachea, pharynx, œsophagus, and numerous vessels and nerves.

Each side is bounded above by the base of the inferior maxilla, the lower border of the parotid region, and the mastoid process of the temporal bone; posteriorly, by a line extending from the occiput, just behind the mastoid process, to the acromion process of the scapula; and below, by the acromion process and the upper border of the clavicle and sternum. The two sides are divided by the median line. One side should be dissected at a time.

To dissect this region, the thorax should be elevated and the position of the head changed from time to time, as it may be found necessary to have the parts relaxed or made tense. The dissector must exercise his own judgment in determining the best position for the head in the different stages of the dissection. As a general rule, muscles should be made tense to facilitate their dissection, but sometimes, in separating them from each other, or when tracing vessels and nerves among them, it is better that they should be relaxed, so that they can be drawn to one side or lifted up.

Before commencing the dissection, the student should ob-

serve the following prominent points in the median line, and the distances they are apart: The chin, the hyoid bone, the thyroid and cricoid cartilages, and the sternum. If the subject be emaciated, he will also be able to feel distinctly the cartilaginous rings of the trachea. It is an excellent plan for the student to familiarize himself with all the prominent points in a region which can be seen or felt in the living body. If they be movable, then he should attentively observe the changes effected by such movements in their relations to each other and to the surrounding parts.

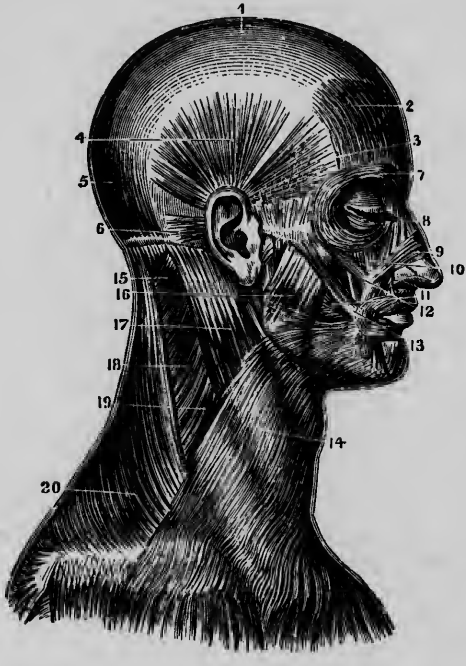
A vertical incision is to be made along the median line, through the skin, from the symphysis of the chin to the upper border of the sternum; and, if the face and thorax have not already been dissected, two horizontal ones will be required; a superior one, extending from the commencement of the first, along the base of the inferior maxilla, to the mastoid process; and an inferior one, commencing at the termination of the first, and continued along the upper border of the clavicle, to the acromion process. In making these incisions, care should be taken to divide nothing but the skin.

The skin is to be carefully dissected up and reflected backwards, leaving the superficial fascia exposed. The platysma myoides is placed between two layers of this fascia. The outer layer is very thin in the lower part of the neck, but quite thick in the upper part, where it usually contains a considerable quantity of adipose tissue. When the fat is very abundant, it forms what is called the double chin. There are no vessels of any importance in this layer, and the only nerves found in it are cutaneous branches derived from the cervical plexus. This layer may now be removed, and the platysma myoides exposed.

To raise the fascia, the student should commence at the chin, and cut down cautiously until he perceives the muscle and observes the direction of its fibres. Having found the muscle, and made its fibres tense by placing the head in a proper position, there can be no difficulty in dissecting off the fascia and leaving the muscle clearly exposed. The strokes of the scalpel must be made, at first slowly and carefully, in the direction of the fibres. If the student attempts to make a rapid dissection of this muscle, he will be very likely to remove more or less of it with the fascia.

The PLATYSMA MYOIDES *arises*, Fig. 61 (14), from the pectoral and deltoid fasciæ, just below the clavicle. Its fibres

Fig. 61.



A SIDE VIEW OF THE SUPERFICIAL LAYER OF MUSCLES ON THE FACE AND NECK.—1. Tendon of the occipito-frontalis. 2. Its frontal belly. 3. Attrahens aurem. 4. Attollens aurem. 5. Occipital belly of the occipito-frontalis. 6. Retrahens aurem. 7. Orbicularis palpebrarum. 8, 8. Levator labii superioris alæque nasi. 9. Compressor naris. 10. Levator anguli oris. 11. Buccinator. 12. Zygomaticus minor. 13. Orbicularis oris and zygomaticus major. 14. Platysma myoides. 15. Splenius. 16. Masseter. 17. Sterno-cleido-mastoid. 18. Levator scapulæ. 19. Scalenus medius. 20. Trapezius.

pass upwards and somewhat forwards over the neck, and are lost in the lower part of the face; some of them decussate at the symphysis of the chin with the corresponding fibres on the opposite side; others end in the skin, or blend with some of the muscles of the mouth, as described in the dissection of the face. This muscle seems to be, in the human

body, a vestige of the panniculus carnosus of the lower animals.

The platysma may now be dissected up from the layer of fascia beneath it, when the following vessels and nerves must be found and studied:—

The EXTERNAL JUGULAR VEIN, Fig. 2, *f*, and Fig. 62 (1, 2, 3), formed generally by the union of the temporal and internal maxillary veins, commences close to the angle of the lower jaw, and passes downwards and backwards over the sterno-cleido-mastoideus, towards the centre of the clavicle, and terminates usually in the subclavian. It is sometimes very small or entirely absent; again, it is very large and sometimes double. It may be large on one side and small on the other. It also varies in its origin and in its termination. As this vein is sometimes opened for the abstraction of blood, it should be particularly noticed. Its direction, in connection with that of the fibres of the platysma, should be observed with reference to the proper mode of opening the vein. It commonly contains two valves—one near its centre and the other near its termination; the first is sometimes wanting.

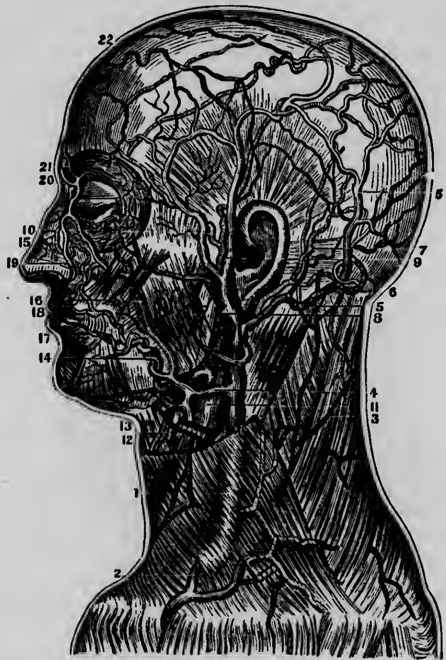
The FACIAL VEIN, Fig. 62 (16), enters the neck along with the facial artery, and passes down in front of the submaxillary gland, while the artery goes behind it. It most commonly unites with the lingual to form a common trunk which opens into the internal jugular. Its termination, however, is so irregular, and of so little consequence, as to deserve no special attention.

The ANTERIOR JUGULAR, Fig. 2, *h*, commences in the submaxillary region, and, passing down on the anterior part of the neck to the upper border of the sternum, dips beneath the sterno-cleido-mastoideus to reach the subclavian. Sometimes, there is no anterior jugular, or it is very small; sometimes, it is quite large on one side and very small on the other; again, it may take the place of the external jugular, which will, in that case, be absent. If the student should have an opportunity to dissect the superficial veins of the neck in several subjects, he will observe the great irregularity which exists in their general arrangement.

The FACIAL ARTERY, Fig. 62 (14), is the only one which deserves any special notice in connection with the superficial

fascia. This artery will be seen passing over the base of the inferior maxilla, just in front of the insertion of the masseter,

Fig. 62.



A Side View of the Superficial Arteries and Veins of the Face and Neck.—1. External jugular vein, seen under the platysma myoides muscle. 2. Anastomosing branch from the cephalic vein of the arm to the external jugular. 3. External jugular after the removal of the platysma muscle. 4. Communication of the external and internal jugulars by means of the facial vein. 5. Occipital vein and branches. 6. Occipital artery. 7. Posterior auricular artery and vein. 8. Point where the external jugular is formed by the union of the temporal and internal maxillary veins. 9. Temporal artery and parietal vein. 10. Frontal branches of the same; on the top of the head are seen the anastomoses of these vessels with the occipital. 11. Internal jugular vein. 12. Superior thyroid artery and vein. 13. Lingual artery and vein. 14. Facial artery. 15. Point of its anastomosis with the nasal branch of the ophthalmic. 16. Facial vein separated from the artery, except at its origin and termination. 17. Inferior coronary artery and vein. 18. Superior coronary artery and vein. 19. Ascending nasal vein. 20. Nasal branches of the ophthalmic artery and vein. 21, 22. Frontal vein.

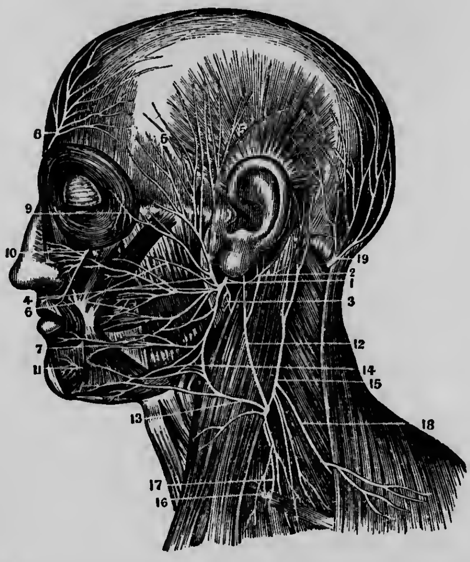
or about an inch from the angle of the jaw. The *submental branch*, Fig. 1 (s), of the facial usually passes up over the lower jaw, near the symphysis of the chin.

The nerves are, the occipitalis minor, the auricularis magnus, the superficialis colli, the cervical branches of the facial, and the supra-clavicular branches.

The Occipitalis Minor, Fig. 63 (15), is a small nerve which passes upwards along the posterior border of the sterno-cleido-mastoideus to the occiput.

The Auricularis Magnus, Fig. 63 (12), arises from the second and third cervical nerves, near the middle of the neck, winds obliquely upwards and forwards over the posterior border of the sterno-cleido-mastoideus, and goes up to the

Fig. 63.



A View of the Facial Nerve, together with the Branches of the Cervical Plexus, &c.—1. The portio dura, or facial nerve, escaping from the stylo-mastoid foramen; the parotid gland has been removed, in order to show the nerve more clearly. 2. Its posterior auricular branch. 3. The stylo-hyoid branch. 4. The pes anserinus. 5. Temporal branches of the facial nerve. 6. Malar branches. 7. Cervico-facial branches. 8. Supra-orbital nerve. 9. Subcutaneus malæ, a branch of the superior maxillary nerve. 10. The infra-orbital nerve. 11. Terminal branches of the inferior dental nerve. 12. Nervus auricularis magnus of the cervical plexus. 13. The superficialis colli nerve. 14. The plexus formed between the superficialis colli and the branches of the facial. 15. The occipitalis minor, a branch of the cervical plexus. 16. Descending branches of the cervical plexus. 17. The phrenic nerve. 18. The spinal accessory of the eighth pair. 19. The great or posterior occipital nerve.

parotid region, crossing in its course the sterno-cleido-mastoideus. It is generally found a short distance behind the external jugular vein, and running nearly parallel to it. Its terminal branches were dissected in connection with the parotid and auricular regions.

The SUPERFICIALIS COLLI, Fig. 63 (13), arises at the same place as the auricularis magnus, passes over the sterno-cleido-mastoideus, and, going transversely across it and beneath the external jugular vein, divides into *ascending* and *descending branches*. The former ascend to the submaxillary region; one or two filaments usually accompany the external jugular vein, and two or three filaments anastomose with the facial beneath the platysma. The latter ramify on the side of the neck, extending to the median line. The superficialis colli sometimes arises, by two trunks, from the cervical plexus. The filaments which accompany the external jugular may be wounded when this vein is opened.

The CERVICAL BRANCH OF THE FACIAL, Fig. 63 (14), leaves the parotid gland near the angle of the lower jaw, beneath which it passes to the anterior and upper part of the neck to near the chin, where it divides into several branches. It runs beneath the platysma, to which it sends filaments. Two or three branches anastomose, as before stated, with the superficialis colli, with which they form a plexus.

The SUPRA-CLAVICULAR AND ACROMIAL NERVES, Fig. 66 (16), arise from the cervical plexus, behind the sterno-cleido-mastoideus, and divide into anterior, middle, and posterior branches. The *anterior* pass downwards and forwards, over the sterno-cleido-mastoideus, to the anterior and lower part of the neck, and, over the inner part of the clavicle, to the thorax; the *middle* go directly downwards to the clavicle, which they pass over to reach the thorax; the *posterior* or *acromial branches* pass over the lower portion of the trapezius, and the acromion process and spine of the scapula, to the shoulder. These nerves are distributed to the platysma myoides and to the integument.

The *superficial fascia* of the neck may be regarded as consisting of the dense areolar tissue which is spread out beneath the skin, being continuous, above, with the superficial fascia of the face, and below with that of the thorax, and containing

the subcutaneous vessels and nerves, the platysma myoides, and lymphatic glands; while the deep cervical fascia is more dense in its structure, has fixed attachments, and contains between its laminæ the deep vessels, nerves, and lymphatic glands, and the muscles. The superficial fascia forms a bond of union between the skin and the deep parts, and retains *in sitû* the subcutaneous vessels, &c. The deep fascia connects together the deep parts, and keeps each one in its proper place. It must be studied as these parts are exposed in the progress of the dissection.

The superficial fascia may now be raised without preserving the vessels and nerves found in it. This can be done on the opposite side. The following muscles may now be dissected:—

The STERNO-CLEIDO-MASTOIDEUS, Fig. 64 (17), is the largest muscle on the side of the neck. It is separated from the platysma myoides by the deep layer of the superficial fascia, the external jugular vein, the auricularis magnus, the superficialis colli, and the anterior branches of the supraclavicular nerves, which have already been dissected, and by a thin layer of the deep cervical fascia. This layer of the deep fascia is frequently so thin, that it is difficult to dissect it up as a distinct lamina; its continuity, however, with the deep fascia, especially at the anterior border of the muscle, will be clearly seen. It *arises* by two heads; one from the upper border of the sternum, and the other from the inner extremity of the clavicle. The sternal origin is the narrowest, and extends tendinous for some distance; the clavicular origin varies very much in width in different subjects, and its tendinous fibres are shorter. The space between these two heads is occupied by areolar tissue; it also varies very much in width in different subjects; sometimes it is scarcely perceptible. The muscle formed by the junction of these two heads passes obliquely upwards and backwards, and is *inserted* into the mastoid process and the superior semicircular ridge of the occipital bone. The action of the two muscles is to approximate the chin to the sternum; if one acts alone, it will turn the chin to the opposite side.

This muscle is exposed by making an incision through the fascia, near its anterior border, from its origin to its insertion, and dissecting the fascia off, so as to observe its connection with the deep layer.

The STERNO-HYOIDEUS, Fig. 64 (18) and Fig. 69 (14), *arises* from the posterior surface of the sternum, sometimes in part from the sterno-clavicular ligament and the clavicle, or the cartilage of the first rib. It passes upwards, and is *inserted* into the body of the hyoid bone. It is quite thin, and from half an inch to three-fourths of an inch in breadth. It is separated from its fellow on the opposite side by a thin layer of fascia, especially in front of the trachea and thyroid gland. The proximity of these muscles should be noticed with reference to tracheotomy.

The OMO-HYOIDEUS, Fig. 64 (16), is a digastric muscle; its two bellies being connected by a small tendon behind the sterno-cleido-mastoideus. Its posterior belly *arises* from the upper border of the scapula, near the coracoid notch, and sometimes from the ligament subtending the notch; its anterior belly *arises* from the body of the hyoid bone. The direction of each belly deserves notice. The anterior one, it will be observed, corresponds in its direction very nearly to a line extending from the body of the hyoid bone to the centre of the clavicle. The posterior belly is more transverse in its direction. The tendon, common to these two bellies, is situated in the deep cervical fascia, and so connected with it as to render the fascia tense when the bellies contract.

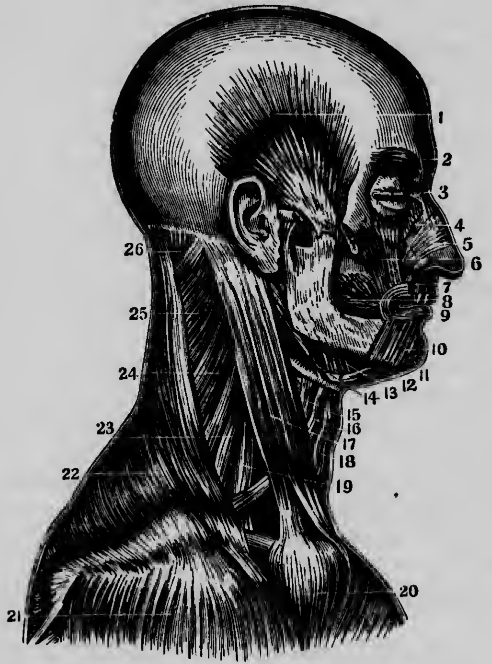
Before dissecting the origin of the posterior belly, the anterior and lower portion of the trapezius may be exposed, and detached from the clavicle and acromion process. This part of the trapezius, Fig. 64 (22), should be dissected now, so that its relation to the supra-clavicular region may be seen.

The STERNO-THYROIDEUS, Fig. 69 (15), *arises* from the posterior surface of the sternum, and sometimes in part from the cartilage of the first or second rib. It passes upwards and is *inserted* into the oblique ridge on the ala of the thyroid cartilage. It is placed behind the sterno-hyoideus, projecting some distance beyond its external border. It does not, however, like that muscle, approximate closely to its fellow on the opposite side, and hence it is not directly concerned in the anatomy of tracheotomy. It is considerably broader than the sterno-hyoideus.

The THYRO-HYOIDEUS, Fig. 64 (15), is a short muscle which *arises* from the thyroid cartilage, and passes over the thyrohyoid space, and is *inserted* into the hyoid bone. It appears

to be a continuation of the sterno-thyroideus, and unless the student is on his guard, it will be dissected up with that muscle.

Fig. 64.



A LATERAL VIEW OF THE DEEP-SEATED LAYER OF MUSCLES ON THE FACE AND NECK.—1. Temporal muscle deprived of its fascia. 2. Corrugator Supercilii. 3. Pyramidalis nasi. 4. Superior or nasal extremity of the levator labii superioris alæque nasi. 5. Compressor naris. 6. Levator anguli oris. 7. Depressor labii superioris alæque nasi. 8. Buccinator. 9. Orbicularis oris. 10. Depressor labii inferioris. 11. Levator labii inferioris. 12. Anterior belly of the digastricus. 13. Mylo-hyoid. 14. Stylo-hyoid. 15. Thyro-hyoid. 16. Upper belly of the Omo-hyoid. 17. Sterno-cleido-mastoid. 18. Sterno-hyoid. 19. Scalenus anticus. 20. Pectoralis major. 21. Deltoid. 22. Trapezius. 23. Scalenus Medius. 24. Levator scapulæ and scalenus posticus. 25. Splenius. 26. Complexus.

If the dissector should find it necessary to detach either of these muscles at one of their extremities, in order to expose another, it should be done so that the muscle can be replaced again in its natural position. The sterno-cleido-mastoideus can be detached at its origin, and raised up for

some distance, without injuring anything of importance. The sterno-hyoideus may also be detached at its origin and turned upwards, so as to dissect the muscle beneath it.

The actions of the three last muscles will be readily understood by observing their attachments.

The sterno-, thyro-, and omo-hyoid muscles, Fig. 67 (6), receive nervous filaments from the descendens noni; the thyro-hyoid is supplied by a filament from the hypoglossal. These nerves may be looked for while dissecting the muscles, or their examination may be postponed until the opposite side is dissected. The same course may be pursued with regard to the arteries going to them.

The DIGASTRICUS, Fig. 69 (1, 2), *arises* from the digastric fossa and mastoid process, and from the base of the inferior maxilla close to the symphysis; the two bellies are *inserted* into an intermediate tendon, which is connected by tendinous fibres to the hyoid bone. The posterior belly is the longest and more transverse in its direction. The tendon of this muscle perforates the anterior extremity of the stylo-hyoideus. A little care is necessary, or this arrangement may be destroyed before it is observed. The deep fascia of the neck is connected to the digastric muscle, which deserves to be noticed. The origin of the posterior belly of this muscle need not be exposed at present, as it is covered by the sterno-cleido-mastoideus. The action of this muscle is to depress the lower jaw, or, when this is fixed, to elevate the hyoid bone.

If the student has been successful thus far in his dissection of the neck, he will encounter but little difficulty in completing it in a manner satisfactory to himself. All the more prominent points are now distinctly brought into view, and their relations to the other parts are such that he will be able to locate and find them without much trouble. He can now readily trace upon the subject the boundaries of the following subdivisions or surgical regions.

Each side of the neck is divided into five regions; the submaxillary, the superior carotid, the inferior carotid, the supra-clavicular, and a fifth one, which is situated behind the sterno-cleido-mastoideus, and above the posterior belly of the omo-hyoideus muscle.

The SUBMAXILLARY REGION is bounded above by the in-

ferior maxilla, below and in front by the anterior belly of the digastricus, below and behind by the posterior belly of the same muscle, and by a process of the deep fascia, which is attached to the stylo-maxillary ligament, and separates this region from the parotid.

The SUPERIOR CAROTID REGION is bounded above by the posterior belly of the digastricus, behind by the sterno-cleido-mastoideus, below and in front by the anterior belly of the omo-hyoideus.

The INFERIOR CAROTID REGION is bounded anteriorly by the median line, above by the anterior belly of the omo-hyoideus, and behind and below by the sterno-cleido-mastoideus.

THE SUPRA-CLAVICULAR REGION is bounded in front by the sterno-cleido-mastoideus, above by the posterior belly of the omo-hyoideus, and below by the clavicle.

The FIFTH REGION, or SUB-OCCIPITAL, is bounded in front by the sterno-cleido-mastoideus, below by the omo-hyoideus, and behind by the trapezius.

A *sixth region*, embracing the parts concerned in the operations of laryngotomy and tracheotomy, or laryngo-tracheotomy, may be conveniently made by the student. It is not necessary, however, to give any specific boundaries to such a region.

The lower part of the neck, embracing the inferior carotid and supra-clavicular regions, and extending upwards to the bifurcation of the common carotid artery, is to be dissected next.

If the sterno-cleido-mastoideus, sterno-hyoideus, and sterno-thyroideus have not been detached at their origins, it should be done now. The overlapping of the sternal origin of the sterno-cleido-mastoideus should be noticed, with reference to ligation of the common carotid artery. Beneath the sterno-hyoid and thyroid are the trachea and thyroid gland. A *plexus of veins*, Fig. 66, coming from the thyroid gland, is usually situated directly in front of the trachea, and is liable to be wounded in tracheotomy.

The *middle thyroid artery*, sometimes called the artery of Neubauer, when present, is found in this region. It is not very often met with, and is so irregular in its origin and

course, that no rule can be laid down for avoiding it in opening the windpipe. There are no nerves in front of the trachea which deserve any special notice. It is separated from the muscles by a layer of the deep fascia, by areolar tissue, and by the thyroid gland.

The THYROID GLAND consists of two lobes, connected across the upper rings of the trachea, usually the second and third. It is of a reddish color and exceedingly vascular. The lobes are situated more on the sides than in front of the trachea. They are somewhat conical in shape; the small end being above. Each one extends from about the sixth ring up to the thyroid cartilage, and projects backwards between the sheath of the common carotid and the windpipe. The portion connecting the two lobes is called the *isthmus*. This varies much in size, a point which deserves special notice in reference to tracheotomy. A small body projects upwards from the isthmus, or from one of the lobes called the *pyramid*, and this again is connected to the hyoid bone by a fibrous structure, which, from its resemblance to muscle in some cases, has been called the *levator glandulæ thyroideæ*.

There is perhaps no organ in the body which presents so great a variety in its development as the thyroid gland. It is not necessary to specify these variations, as the student will be able to note them as he happens to meet with them in his dissections. Whatever may be the office of the thyroid gland, whether of great or little importance in the economy, it is liable to abnormal or pathological changes, which are of the utmost consequence to the physician.

It has no excretory duct, and, consequently, cannot be classified with the true glands which elaborate and secrete a known fluid. Its arteries are derived from the subclavian and external carotid. At this stage of the dissection, the student will observe merely the terminal branches of the thyroid arteries. Those of the inferior thyroid will be seen entering for the most part the under surface of the lower portion of the gland, while those of the superior penetrate the anterior surface of the upper part. This mode of entering the gland seems to result from, or at least to correspond to, the superficial and deep situation of the superior and inferior thyroid arteries.

The veins go to form the tracheal plexus, which has been alluded to in connection with the anterior relations of the trachea.

The anterior part of the larynx may now be noticed, especially the crico-thyroid space, as connected with the operation of laryngotomy. A small artery crosses this space transversely, resting upon the anterior crico-thyroid ligament, and sending a branch through it to the mucous membrane. The anterior portion of the cricoid and thyroid cartilages should also be inspected *in sitû.*

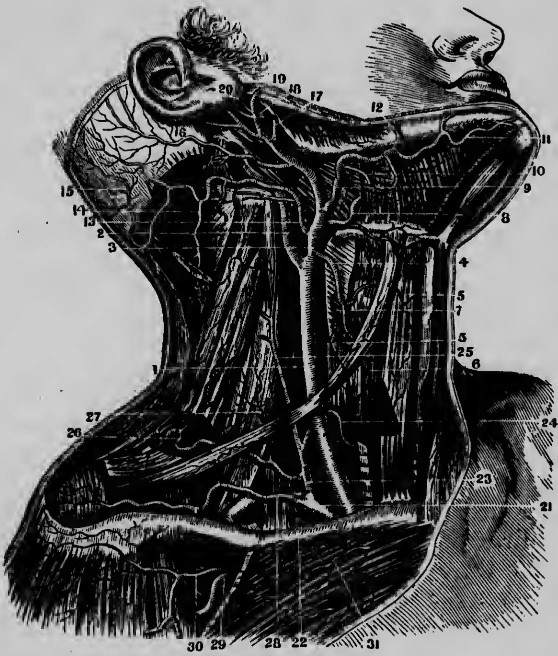
When the parts in front of the trachea and larynx have been duly examined, the dissection is to be continued in a lateral direction. As the two sides of the neck differ in this region in some material points, the right side will be examined first, and the peculiarities of the left will be noticed in another place.

The first thing to be sought in this region is the ARTERIA INNOMINATA, Fig. 66 (10). This will be found immediately beneath the sterno-clavicular articulation, covered by fascia. Only the upper portion of it will be seen in the dissection of the neck. When its bifurcation into the common carotid and the subclavian is found, the sheath of the former may be laid open to near its division into the external and internal carotids. Before doing this, however, the relation of the omohyoideus to the artery should be observed; also, the course of the *descendens noni nerve*, which lies upon the sheath common to the artery and internal jugular vein. Some small nervous filaments will be noticed crossing the artery, and which are liable to be divided in ligating it. Having exposed the common carotid, the following parts will be found without difficulty:—

On the outside, and running parallel to it, is the INTERNAL JUGULAR. As this vein is traced downwards, it will be seen that it does not terminate at the commencement of the carotid, Fig. 66 (16), but passes over the subclavian artery to join the subclavian vein, and with it form the *vena innominata.* By separating the carotid from the jugular vein, the *pneumogastric nerve* will be brought into view. It lies behind and between these great vessels, and in the same sheath. It may be traced downwards over the subclavian artery, where it gives off the *inferior laryngeal branch*, which winds round the

posterior surface of the subclavian artery to ascend to the larynx.

Fig. 65.



A View of the Arteries of the Neck and Shoulder.—1. Primitive carotid artery. 2. Internal carotid artery. 3. External carotid artery. 4. The superior thyroid artery. 5. Branches to the muscles. 6. Main branch to the gland. 7. Inferior pharyngeal artery. 8. Lingual artery. 9. Facial artery. 10. Its branches to the submaxillary gland. 11. Submental branch. 12. Principal branch of the facial as it goes over the jaw. 13. Occipital artery. 14. Branches to the muscles on the back of the neck. 15. Main trunk to the occiput. 16. Posterior auricular artery. 17. A branch cut off, which goes to the parotid gland. 18. Origin of the internal maxillary artery. 19. Origin of the temporal artery. 20. Origin of the anterior auricular. 21. The subclavian. 22. Origin of the internal mammary. 23. Trunk of the inferior thyroid, from which arise in this subject the anterior and posterior cervical arteries. 24. Branch of the inferior thyroid going to the thyroid gland. 25. Ascendens colli going up the neck. 26. Posterior or transverse cervical. 27. Branches to the scaleni and levator scapulæ muscles. 28. The supra-scapular artery. 29. The thoracica acromialis of the axillary artery. 30. A branch to the deltoid. 31. Recurrent branches of the intercostals.

This branch of the pneumogastric may be traced from its origin to its entrance into the larynx. Leaving the artery and proceeding a short distance obliquely inwards and up-

wards, it gets into the groove formed by the trachea and œsophagus, and continues in this groove to the lower border of the inferior constrictor muscle of the pharynx, to which it gives some filaments; it then passes round outside the crico-thyroid articulation, to divide into branches to supply all the muscles of the larynx except the crico-thyroid. While in connection with the subclavian artery, it gives off branches to join the cardiac branches of the sympathetic. It also, in its course, sends filaments to the trachea, œsophagus, and thyroid gland. The situation of this nerve is to be noticed as connected with œsophagotomy.

About an inch and a half from the bifurcation of the arteria innominata, the *inferior thyroid artery* passes transversely beneath the common carotid, the internal jugular, and the pneumogastric nerve. The course of this artery should be observed as connected with the ligation of the carotid, and also with œsophagotomy.

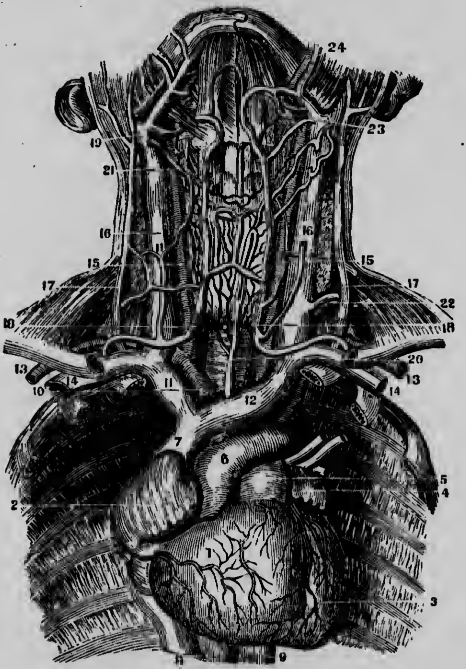
The dissection is now to be extended along the course of the SUBCLAVIAN ARTERY, Fig 65 (21). This artery, from its relations to the scalenus anticus muscle, is divided into three sections: the *first* extends from its commencement to the inner border of the scalenus; the *second* includes that portion directly behind the muscle, and the *third* division extends from the outer border of this muscle to the point where it passes over the first rib to terminate in the axillary artery.

The *deep cervical fascia* in this region is quite thick and dense. It is firmly attached to the clavicle and first rib. The vessels and nerves, and the scalenus anticus, obtain investments from it. A prolongation is also sent down from it into the thorax, along with the trachea and the large vessels and nerves which enter that cavity from the neck. The dissection of this region is somewhat difficult. The parts will be noticed in the order in which they seem most naturally to present themselves to the dissector. The internal jugular vein and the pneumogastric nerve may be divided some distance above the subclavian artery, and reflected downwards. Filaments of the sympathetic may be noticed passing over the artery to enter the thorax.

The BRANCHES of the subclavian artery are numerous, and, with the exception of one, have their origin on the inner side of the scalenus. The *thyroid axis*, as it is called, is sometimes the common origin of the inferior thyroid, the supra-

scapular, and the transverse humeral. As these branches, so frequently arise separately, although near to each other, the term "thyroid axis" might very properly be abandoned.

Fig. 66.



A View of the Heart, with the Great Vessels of the Neck in Situ.—1. Right ventricle of the heart. 2. Right auricle. 3. Left ventricle. 4. Left auricle. 5. Pulmonary artery. 6. Arch of the aorta. 7. Descending vena cava at its entrance into the right auricle. 8. Ascending vena cava. 9. Thoracic aorta. 10. Arteria innominata. 11. Right brachio-cephalic vein. 12. Left brachio-cephalic vein. 13. Section of the subclavian artery. 14. Section of the subclavian vein. 15, 15. Primitive carotid arteries. 16, 16. Internal jugular veins. 17, 17. External jugular veins. Between these veins is seen the section of the sterno-cleido-mastoid muscle. 18. The trunk formed by the superficial cervical veins, known sometimes as the anterior jugular vein. 19. A branch from it to the facial. 20. Main trunk from the inferior thyroid veins. 21. Superior thyroid vein. 22. Transverse cervical artery and vein. 23. Lingual artery and vein. 24. Facial artery and vein.

The Inferior Thyroid, Fig. 65 (23), comes off from the anterior and upper aspect of the artery, a short distance from the scalenus; it passes upwards about an inch, when it

turns inwards and dips beneath the jugular vein, common carotid artery, and pneumogastric nerve, to go to the thyroid gland, to which the greater part of it is distributed. It sends small branches to the œsophagus, the trachea, and to the larynx. The middle cervical ganglion of the sympathetic, when it exists, rests upon it.

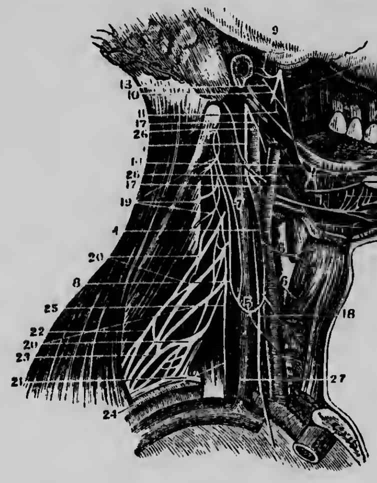
The ASCENDENS COLLI, Fig. 65 (25), is usually a branch of the thyroid; the point of its origin, however, varies; sometimes it comes off as the thyroid turns inwards, and if it be large, causes the appearance of a bifurcation of that artery. It ascends upon the scalenus anticus on the neck, giving branches to this muscle and to the rectus capitis anticus major, and the levator anguli scapulæ. It also gives off branches to anastomose with the vertebral artery, and to enter the spinal canal along with the cervical nerves.

The SUPRA-SCAPULAR ARTERY, Fig. 65 (28), passes transversely outwards, just behind the clavicle, to reach the coracoid notch; it does not usually pass through the notch, but immediately over the ligament which converts it into a foramen. It is situated beneath the deep fascia, and in its course gives off a small branch which enters the thorax. On the dorsum of the scapula it anastomoses beneath the acromion with the arteria dorsalis scapulæ.

The TRANSVERSE HUMERAL, or CERVICAL, Fig. 65 (26), passes transversely outwards, but above the preceding, to the trapezius. It is distributed to the muscles on the back of the neck, and anastomoses with the arteria princeps cervicis, a branch of the occipital artery. Both of the last named arteries are to be studied in their relations to the operation for ligating the subclavian artery.

The INTERNAL MAMMARY ARTERY, Fig. 65 (22), arises from the lower surface of the subclavian, and very soon enters the thorax. It passes beneath the clavicle, the subclavian vein, and the phrenic nerve, before it gets behind the first rib. Its course in the thorax, and in the anterior walls of the abdomen, will be noticed in the dissection of those parts. It may be mentioned now that it anastomoses with several arteries, as the superior thoracic, the intercostal, and the epigastric. These anastomotic connections render its study important.

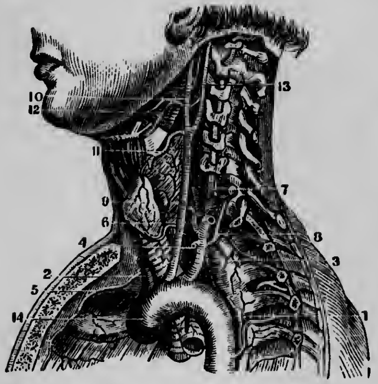
Fig. 67.



THE COURSE AND DISTRIBUTION OF THE HYPOGLOSSAL OR NINTH PAIR OF NERVES. THE DEEP-SEATED NERVES OF THE NECK ARE ALSO SEEN.—1. The hypoglossal nerve. 2. Branches communicating with the gustatory nerve. 3. A branch to the origin of the hyoid muscles. 4. The descendens noni nerve. 5. The loop formed with the branch from the cervical nerves. 6, 6. Muscular branches to the depressor muscles of the larynx. 7. A filament from the second cervical nerve, and 8. A filament from the third cervical, uniting to form the communicating branch with the loop from the descendens noni. 9. The auricular nerve. 10. The inferior dental nerve. 11. Its mylo-hyoidean branch. 12. The gustatory nerve. 13. The chorda tympani passing to the gustatory nerve. 14. The chorda tympani leaving the gustatory nerve to join the submaxillary ganglion. 15. The submaxillary ganglion. 16. Filaments of communication with the lingual nerve. 17. The glosso-pharyngeal nerve. 18. The par vagum or pneumogastric nerve. 19. The three upper cervical nerves. 20. The four inferior cervical nerves. 21. The first dorsal nerve. 22, 23. The brachial plexus. 24, 25. The phrenic nerve. 26. The carotid artery. 27. The internal jugular vein.

The VERTEBRAL ARTERY, Fig. 68 (7), is the largest branch of the subclavian. It arises from the upper and posterior part of that artery, and passes directly up to the foramen in the transverse process of the sixth cervical vertebra, which it traverses, and also the corresponding foramina of the upper five vertebræ; it enters the cranial cavity through the foramen occipitale, to be distributed to the brain and its meninges. In its course along the neck it sends branches to the spinal canal, and gives off also some small muscular twigs. It varies in its origin in different subjects, and on

Fig. 68.



A View of the Vertebral Artery, Carotid and Arch of the Aorta, as given by a Vertical Section of the Neck.—1. Commencement of the thoracic aorta. 2. The innominata at its origin. 3. The left subclavian. 4. The internal mammary artery. 5. The artery of the right side. 6. The inferior thyroid. 7. The vertebral in the transverse processes of the cervical vertebræ. 8. Superior intercostal artery. 9. Left primitive carotid. 10. External carotid artery. 11. Superior thyroid. 12. The lingual, which has here a common trunk with the facial. 13. Internal carotid. 14. Origin of the aorta.

the two sides in the same subject; also in the number of transverse processes through which it passes.

From the posterior part of the subclavian two branches arise, sometimes separately and sometimes by a common trunk—the superior intercostal and the profound cervical.

The Superior Intercostal passes over the neck of the first rib and enters the superior intercostal space; on the right side, it very frequently supplies the upper two intercostal spaces.

The Profound Cervical passes backwards between the transverse process of the seventh cervical vertebra and the first rib. It assists in supplying the deep muscles on the back. The small *veins* in this region correspond to the branches of the subclavian artery.

The Phrenic Nerve, Fig. 67 (24), arises from the third and fourth cervical, and passes obliquely downwards and inwards over the scalenus anticus to enter the thorax. The subclavian vein lies in front of it, and the internal mammary artery behind it. It communicates usually by one or two filaments with the descendens noni; it is also generally connected by a branch of considerable size with the fifth cervical nerve. As it crosses the scalenus it is bound down by fascia.

The Subclavian Vein, Fig. 66 (14), extends from the sterno-clavicular articulation to the first rib, on the inner side of the scalenus anticus, which separates it from the subclavian artery. It is more superficial than the artery, and on a plane

lower down. It receives the external jugular, which usually enters it a little on the outside of the scalenus, or in front of it. The external jugular occasionally terminates in the internal jugular. The veins corresponding to the supra-scapular and transverse humeral arteries enter the subclavian.

The SCALENUS ANTICUS MUSCLE, Fig. 71 (2), *arises* from the transverse processes of the third, fourth, fifth, and sixth cervical vertebræ, and is *inserted* in a tubercle on the first rib. It draws the first rib up, or turns the head to one side. This muscle and the tubercle which indicates the point of its insertion furnish important guides for finding the subclavian artery, and, on this account, they demand the special attention of the student. This muscle may now be detached from the rib and turned upwards, when the *middle* division of the subclavian artery is brought into view. It is in relation with the pleura, first rib, the lower cervical and first dorsal nerves, and the anterior and middle scaleni muscles.

The POSTERIOR CERVICAL ARTERY usually arises from the outer portion of this division. This artery passes transversely outwards to be distributed to the muscles on the back; sometimes it is a branch of the transverse humeral. It is liable to be injured in ligating the subclavian artery between the scalenus anticus and the first rib.

Outside the scalenus anticus is the SUPRA-SCAPULAR NERVE, which arises from the fifth cervical and passes downwards and backwards, beneath the trapezius and omo-hyoideus, to reach the coracoid notch of the scapula. It enters the supra-spinata fossa, and is distributed to the parts on the dorsum of the scapula.

The *third* division of the subclavian artery and the nerves which form the brachial plexus are in this region. The artery passes over the first rib to terminate in the axillary. The nerves lie partly behind and above it, but in close relation to it. The scalenus medius is sometimes perforated by one or more of them. The superior and long thoracic branches generally have their origin from these nerves above the clavicle.

The SCALENUS, MEDIUS and POSTICUS, may be considered as a single muscle which *arises* from the transverse processes of the inferior six cervical vertebræ, and is inserted into the first and second ribs.

The upper part of the superior carotid and the submaxillary regions will be described separately, as far as the student will be able to dissect conveniently the parts which they contain, without destroying or displacing too much their boundaries. Some parts will be partly brought into view and noticed without their being fully dissected and exposed until a more advanced stage of the dissection; and some which are deep-seated can be dissected better without reference to regions, as the deep muscles, the sympathetic, and the nerves generally in the upper and deep part of the neck, consequently these will be described under the head of the *deep parts of the neck.*

The submaxillary region contains the SUBMAXILLARY GLAND, Fig. 3 (3), which should be dissected first, on account of its size and the important relations which it sustains to the vessels and nerves of that region. This gland is covered by a layer of the deep fascia in which it is embedded. It is of an irregular shape; the transverse diameter being somewhat greater than the vertical. In structure, it resembles the other salivary glands. Anteriorly, it projects over the mylo-hyoideus, and sends a prolongation beneath it; below, it is in relation with the digastric and stylo-hyoid muscles; posteriorly, it rests against the process of the deep fascia which is attached to the stylo-hyoid ligament; above, it occupies a fossa on the inner surface of the lower jaw. There are several lymphatic glands situated in this region around the submaxillary gland. They receive lymphatics from the mouth, face, and pharynx; hence they are liable to become affected in cases of disease located in either of these regions. An enlarged lymphatic gland, in the immediate vicinity of the submaxillary, might be mistaken for disease of the submaxillary gland itself.

In dissecting this gland, the following parts will be brought into view:—

The FACIAL ARTERY, Fig. 65 (9), passes beneath its posterior extremity, occupying a sulcus in its substance, and sending branches to it. The *submental branch* (11) of the same artery gives small branches to the gland, and passes forwards over the mylo-hyoideus to near the symphysis of the chin, where, after giving branches to the parts beneath the chin, it goes up over the jaw to the face. The facial artery usually gives

off two or three other small branches in this region, one to the pterygoideus internus, and another to the soft palate.

The Hypoglossal Nerve, Fig. 67 (1), enters the anterior and lower part of the submaxillary region from beneath the digastricus and stylo-hyoideus; runs a short distance before it gets on the anterior surface of the hyo-glossus, just above the greater cornu of the hyoid bone; it then passes upwards and forwards between the hyo-glossus and mylo-hyoideus to reach the tongue. In its course through this region it gives off branches to the thyro-hyoideus, stylo-glossus, and hyo-glossus, and to anastomose with the gustatory branch of the fifth nerve.

The Gustatory or Lingual Branch, Fig. 67 (12), of the fifth enters this region at the anterior border of the pterygoideus internus, and partly behind the gland. This nerve is brought into view by separating the gland from the lower jaw, and loosening it up from the hyo-glossus. It passes over the hyo-glossus and along the stylo-glossus muscle, in nearly a transverse direction, to the genio-hyo-glossus, which it perforates, to go to the sublingual gland and mucous membrane of the mouth. With a very little care in exposing this nerve, the *submaxillary ganglion* may be observed connected to its lower border, and situated nearly opposite the centre of the submaxillary gland. From this ganglion filaments are sent to the substance of the gland, and to the duct of Wharton, and mucous membrane of the mouth. The ganglion is quite small, of a grayish color, and often appears like a slight projection from the nerve. It is classed with the cranial ganglia of the sympathetic. The vidian nerve is said to terminate in it after accompanying for some distance the gustatory.

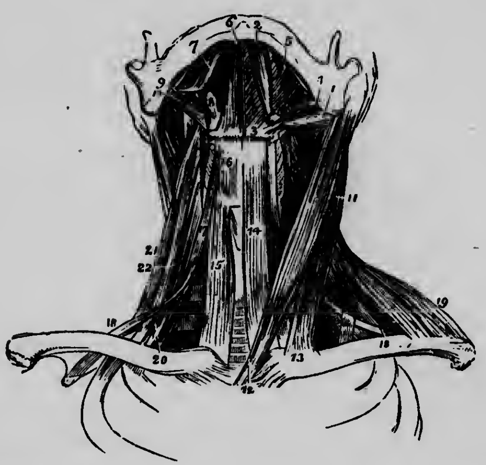
The Mylo-Hyoid branch of the inferior dental nerve enters this region above the gland, and close to the inner surface of the jaw, and gets on the cutaneous surface of the mylo-hyoideus, to which, and the digastricus, it sends filaments, and also to the gland.

The anterior belly of the digastricus may now be detached from the lower jaw, and reflected downwards without destroying its attachment to the hyoid bone. The insertion of the stylo-hyoideus may also be observed at the same time. Removing the areolar tissue, mylo-hyoid nerve, submental

artery and vein, and the anterior projection of the gland, from the cutaneous surface of the mylo-hyoideus, the origin and insertion of this muscle will be exposed.

The MYLO-HYOIDEUS, Fig. 69 (5), is a broad muscle, and from its important relations deserves special notice. It *arises*

Fig. 69.



THE MUSCLES OF THE ANTERIOR ASPECT OF THE NECK; ON THE LEFT SIDE THE SUPERFICIAL MUSCLES ARE SEEN, AND ON THE RIGHT THE DEEP.—1. The posterior belly of the digastricus muscle. 2. Its anterior belly. The aponeurotic pulley, through which its tendon is seen passing, is attached to the body of the os hyoides. 3, 4. The stylo-hyoideus muscle, transfixed by the posterior belly of the digastricus. 5. The mylo-hyoideus. 6. The genio-hyoideus. 7. The tongue. 8. The hyo-glossus. 9. The stylo-glossus. 10. The stylo-pharyngeus. 11. The sterno-mastoid muscle. 12. Its sternal origin. 13. Its clavicular origin. 14. The sterno-hyoid. 15. The sterno-thyroid of the right side. 16. The thyro-hyoid. 17. The hyoid portion of the omo-hyoid. 18, 18. Scapular portions; on the left side, the tendon of the muscle is seen to be bound down by a portion of the deep cervical fascia. 19. The clavicular portion of the trapezius. 20. The scalenus anticus of the right side. 21. The scalenus posticus.

from the mylo-hyoid ridge, on the inner surface of the lower jaw; its fibres pass downwards, forwards, and inwards, to be *inserted* into the hyoid bone, and to join its fellow on the opposite side along the median line. This muscle may draw up the hyoid bone, or, when it is fixed, may depress the lower jaw. A small triangular space, occupied by areolar tissue, exists between the two mylo-hyoid muscles just

below the symphysis of the chin. This muscle should be carefully detached from the mylo-hyoid ridge, and from the hyoid bone, and reflected to the opposite side, when the *hypoglossal* and *gustatory nerves*, and the *duct of Wharton* will be seen resting on the hyo-glossus. The duct, for a short distance after leaving the gland, is situated between these nerves, but nearer to the gustatory than the hypoglossal, which crosses it.

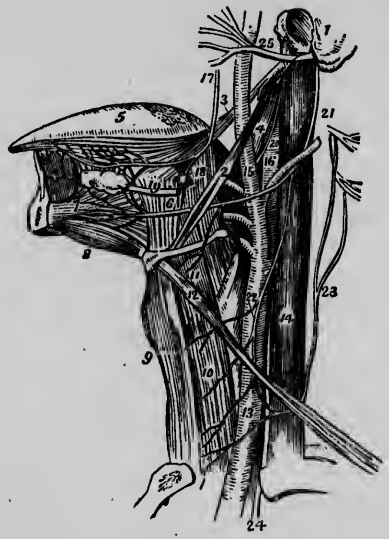
The DUCT OF WHARTON is nearly two inches in length; its walls are very thin in proportion to its caliber. It leaves the hyo-glossus, and gets at first between the genio-hyo-glossus and the sublingual gland, then between the gland and the mucous membrane, between which it continues to the frænum of the tongue, just behind the incisor teeth. The student will have no difficulty in tracing this duct, if an incision be made into it near its origin, and a bristle introduced and carried through it into the mouth. Its proximity to the cavity of the mouth, in the latter part of its course, and the distensible character of its parietes, deserve notice, with reference to ranula, or an enlargement of the duct from closure of its buccal orifice.

The GENIO-HYOIDEUS, Fig. 69 (6), is a small muscle which *arises* from the lower jaw, near the symphysis, and passes downwards and backwards, and is *inserted* into the hyoid bone. The two genio-hyoidei muscles are frequently so closely connected along the median line that it is not easy to separate them. The action of this muscle is nearly the same as that of the preceding one. After detaching this muscle from its origin, and reflecting it downwards, the anterior border of the genio-hyo-glossus will be seen. The genio-hyoid part of it may now be observed, but its connection with the tongue must be examined when that organ is dissected. The submaxillary gland may next be removed entirely, when the hyo-glossus, the stylo-glossus, the stylo-pharyngeus, the lingual artery, and the sublingual gland, with a portion of the mucous membrane of the mouth, will be brought into view.

The STYLO-GLOSSUS, Fig. 70 (3), *arises* from the styloid process and stylo-maxillary ligament, passes downwards and forwards to be lost principally in the side of the tongue. As it enters this organ its fibres spread out, and a few of

them pass transversely across it. It acts on the sides and tip of the tongue.

Fig. 70.



THE ANATOMY OF THE SIDE OF THE NECK, SHOWING THE NERVES OF THE TONGUE. —1. A fragment of the temporal bone containing the meatus auditorius externus, mastoid, and styloid processes. 2. The stylo-hyoid muscle. 3. The stylo-glossus. 4. The stylo-pharyngeus. 5. The tongue. 6. The hyo-glossus muscle; its two portions. 7. The genio-hyo-glossus muscle. 8. The genio-hyoideus; they both arise from the inner surface of the symphysis of the lower jaw. 9. The sterno-hyoid muscle. 10. The sterno-thyroid. 11. The thyro-hyoid, upon which the thyro-hyoidean branch of the hypoglossal nerve is seen ramifying. 12. The omo-hyoid crossing the common carotid artery (13), and internal jugular vein (14). 15. The external carotid giving off its branches. 16. The internal carotid. 17. The gustatory nerve giving off a branch to the submaxillary ganglion (18), and communicating a little further on with the hypoglossal nerve. 19. The submaxillary, or Wharton's duct, passing forwards to the sublingual gland. 20. The glosso-pharyngeal nerve, passing in behind the hyo-glossus muscle. 21. The hypoglossal nerve curving around the occipital artery. 22. The descendens noni nerve, forming a loop with (23) the communicans noni, which is seen to be arising by filaments from the upper cervical nerves. 24. The pneumogastric nerve, emerging from between the internal jugular vein and common carotid artery, and entering the chest. 25. The facial nerve, emerging from the stylo-mastoid foramen, and crossing the external carotid artery.

The HYO-GLOSSUS, Fig. 70 (6), is a thin square muscle, which *arises* from the body and great cornu of the hyoid bone; its fibres pass upwards and are *inserted* into the tongue,

between the stylo-glossus, with which its fibres intermix, and the lingualis.

The LINGUAL ARTERY, Fig. 65 (8), enters the submaxillary region a short distance outside the free extremity of the great cornu of the hyoid bone, and on a plane somewhat deeper. It almost immediately passes behind the hyo-glossus muscle, just above the cornu of the hyoid bone, to get between the genio-hyo-glossus and lingualis. The middle constrictor of the pharynx lies behind it, in the first part of its course. The situation and relations of this artery should be noticed with reference to the application of a ligature to it.

The STYLO-PHARYNGEUS MUSCLE, Fig. 70 (4), *arises* from the styloid process, passes downwards and inwards to the pharynx, which it enters between the superior and middle constrictors. The *glosso-pharyngeal nerve* runs along the side of this muscle between it and the stylo-glossus to the margin of the hyo-glossus, beneath which it passes to the base of the tongue, sending filaments in this region to the pharyngeal plexus. The dissector will find the stylo-pharyngeus muscle a guide for finding this nerve.

The SUBLINGUAL GLAND, Fig. 3 (5), is the smallest of the three large salivary glands. It is situated near the symphysis of the chin, occupying a fossa on the inner side of the lower jaw. Its upper surface is covered by the mucous membrane of the mouth, between the incisor teeth and the tongue; below, it rests upon the mylo-hyoideus muscle; anteriorly, it is in relation with the lower jaw. It is sometimes connected by a process with the submaxillary gland. Its excretory ducts are ten or twelve in number. They open into the mouth near the frænum of the tongue. Sometimes they are called the *ducts of Rivinus*. A communication occasionally exists between these ducts and the duct of Wharton.

The relations of the submaxillary and sublingual glands are worthy of particular notice. It will be observed that the submaxillary is covered externally by skin, superficial fascia, platysma myoides, and deep fascia, while the sublingual is covered internally by mucous membrane, and submucous areolar tissue. The mylo-hyoideus forms the principal septum between them. They are both in apposition with the lower jaw; the sublingual occupying the sublingual fossa,

and the submaxillary the submaxillary fossa, while the two fossæ are separated by the mylo-hyoid ridge.

In dissecting the upper part of the superior carotid region, the first thing which should be sought is the hypoglossal nerve. This enters it beneath the posterior belly of the digastricus, at a point almost directly below the angle of the lower jaw, passes downwards, forwards, and upwards, to enter the submaxillary region near the free end of the great cornu of the hyoid bone. It thus forms a curve in this region, the convexity of which looks downwards. The lowest part of this curve is about three-fourths of an inch below the digastricus. As it descends beneath the digastricus, it gives off the descendens noni.

The DESCENDENS NONI, Fig. 67, (4, 5), passes vertically downwards, receiving one or two branches from the second cervical nerve, or cervical plexus, by which a *loop* is formed; from the convexity of this loop, filaments are sent to the omohyoideus and sterno-hyoideus and thyroideus. The apparent origin of this varies in different subjects. Sometimes it seems to come from the pneumogastric, occupying, in this case, for a short distance, the groove behind and between the common carotid and internal jugular vein; again, it will be found leaving the hypoglossal high up in the parotid region.

If there be any difficulty in finding the nerve in the upper part of this region, it is better either to find one of its branches and trace it upwards, or to trace the hypoglossal nerve itself up into the parotid region. In this way the student will be certain to find it. The descendens noni usually, near its commencement, winds round the occipital artery. As this nerve lies on the sheath of the common carotid, it is liable to be injured in ligating that artery.

The SPINAL ACCESSORY NERVE passes through the upper and posterior part of this region, to perforate the sterno-cleido-mastoideus. It is is most readily found by carefully dissecting the inner and posterior surface of that muscle, and looking for the nerve as it enters it. Occasionally, the nerve passes beneath the muscle.

The *superior laryngeal branch* of the pneumogastric may be found with the laryngeal branch of the superior thyroid artery, between the hyoid bone and the thyroid cartilage. They pass beneath the thyro-hyoid muscle, to perforate the thyro-

hyoid membrane. This nerve can be exposed more conveniently at another stage of the dissection of the neck. Having found this portion of it, the student may avoid destroying it as he proceeds.

As the lower part of the inferior carotid region has already been dissected, the student will have no difficulty in tracing the arteries in its upper part. The common carotid usually bifurcates at a point nearly opposite to the superior border of the thyroid cartilage. The external is at first more internal than the internal carotid itself. It gives off the following branches before passing beneath the digastricus:—

The SUPERIOR THYROID, Fig. 65 (4), arises near the bifurcation, passes inwards, forwards, and downwards, beneath the omo-hyoideus and sterno-thyroideus, to be distributed to the upper and anterior portion of the thyroid gland. It usually gives off the *laryngeal branch*, which goes to the thyro-hyoid space to enter the larynx; the *cricoid branch*, which rests on the anterior crico-thyroid ligament; a branch to the sterno-cleido-mastoideus; and branches to the muscles with which it is connected. This artery is quite superficial in its course.

The *lingual* arises just above the preceding, and passes upwards and inwards to enter the submaxillary region. It is deep-seated in its whole course.

The *facial artery* comes off just below the digastric muscle, and goes up into the submaxillary region.

The *inferior* or *ascending pharyngeal* arises near the bifurcation and from the deep part of the artery, and goes upwards to the jugular foramen, through which it enters the cavity of the cranium, sending branches, as it ascends, to the pharynx and soft palate.

The OCCIPITAL, Fig. 65 (13), arises from the posterior part of the artery, passes upwards and backwards, at first behind the digastricus, and then more horizontally beneath the sterno-cleido-mastoideus, trachelo-mastoideus, and splenius capitis, to reach the occiput. It emerges beneath the integument and fascia, just outside the cranial origin of the trapezius. It gives off branches to the muscles along its course, and, just before it ascends on the occiput, it sends downwards quite a large branch, called the *arteria princeps cervicis;* this branch descends on the back of the neck, and anastomoses with the transverse humeral. The occipital artery ramifies on the back of the head, beneath the skin.

The POSTERIOR AURICULAR, Fig. 65 (16), arises above, or in common with, the occipital, and passes upwards and backwards between the mastoid process and meatus auditorius. It ramifies on the external ear, and beneath the integument behind the ear.

The *styloid* is more frequently a branch of the posterior auricular; it enters the foramen stylo-mastoideum, and goes to the middle ear.

Besides the branches just mentioned, the external carotid generally sends two or three small ones to the sterno-cleido-mastoideus.

SECT. II.—DISSECTION OF THE DEEP PARTS OF THE NECK.

The examination of these parts requires a displacement of the lower jaw, or at least the half on the side upon which they are to be dissected. The only additional section which will be required will be through the symphysis of the chin, when the remaining portions of the jaw upon that side may be drawn upwards and forwards, out of the way, or they may be entirely removed.

The parts to be examined in the present dissection are the internal carotid artery, the internal jugular vein, the pneumogastric, the glosso-pharyngeal, the spinal accessory, the hypoglossal, and the sympathetic nerves, and the pharyngeal plexus, and some of the deep muscles of the neck. Most of the parts just enumerated have been examined as they were found in the different regions already dissected. The following description, therefore, will be confined principally to those portions of them which remain to be exposed.

The branches of the external carotid may be cut away, as the dissector shall find it necessary, in the progress of the dissection. The digastricus and the stylo-hyoideus may be divided near their hyoid attachments, and reflected backwards.

The INTERNAL CAROTID, Fig. 65 (2), passes upwards nearly in a vertical direction from the bifurcation of the common carotid, to the foramen caroticum in the petrous portion of the temporal bone, through which it enters the cranial cavity. In the superior carotid region, it is quite superficial, being covered merely by the integument, platysma myoides, and

the superficial and deep fasciæ; but, as it ascends, it gradually becomes deeper seated. Its size is not varied in this part of its course.

Below the digastricus, the hypoglossal nerve and the occipital artery cross it in front, while the external carotid lies on the inner side of it. Above the digastricus, and in the parotid region, it is crossed in front by the glosso-pharyngeal nerve and the stylo-glossus and stylo-pharyngeus muscles, Fig. 67, which pass between it and the external carotid. It is also covered by the parotid gland, in which it is sometimes partially lodged.

On its inner side are the pharynx and sympathetic nerve. Externally it is in relation with the internal jugular, the pneumogastric, the hypoglossal, and glosso-pharyngeal nerves. These nerves at first lie behind it, but soon get on the outside between it and the vein. The two latter, however, do not continue in this connection down to the common carotid, but cross over in front of the artery, the one above, and the other below the digastricus, as before mentioned.

Behind, it rests on the rectus capitis anticus major, separated from it by fascia and by the pharyngeal and superior laryngeal branches of the pneumogastric, which pass inwards beneath it.

The inferior or ascending pharyngeal artery runs at first on the inner side of the internal carotid, then behind it, up to the foramen lacerum posterius, or jugular foramen. The internal carotid is surrounded by a plexus of nerves.

The relation of this artery to the pharynx is worthy of notice. It sustains nearly the same relation to the internal surface of the pharynx, as regards the intermediate structures, that it does to the external surface of the neck in the superior carotid region.

The Internal Jugular Vein, Fig. 67 (27), commences at the foramen lacerum posterius, and terminates by uniting with the subclavian to form the vena innominata. Near the foramen it is removed a short distance from the internal carotid, the intermediate space being occupied by nerves. There is also a small space between it and the common carotid in the lower part of the neck. This vein is a continuation of the lateral sinus; it increases in size as it receives collateral branches in its course down the neck. It

presents two enlargements, one near its commencement, and the other just above its termination. It has no valves.

The Glosso-Pharyngeal Nerve, Fig. 67 (17), is a part of the eighth. It passes through the foramen lacerum posterius in a fibrous canal by itself. It descends, at first between the internal jugular and internal carotid, then in front of the artery and behind the styloid process and its muscles; it now turns inwards, and passing in front of the stylo-pharyngeus, gets between it and the stylo-glossus; continuing this course, it passes beneath the hyo-glossus, and enters the base of the tongue, to terminate in the papillæ of the mucous membrane.

There are two *ganglia* or *gangliform swellings* on this nerve; a small one in the foramen lacerum, and a larger one, the *petrous* or *ganglion of Andersch*, a little lower down. From the ganglion of Andersch proceed branches to anastomose with the sympathetic, the facial, the pneumogastric, and the nerves in the middle ear. The glosso-pharyngeal receives filaments from the spinal accessory, by which it becomes partly a motor nerve in its distribution. Its muscular branches are sent to the stylo-pharyngeus, stylo-hyoideus, digastricus, hyo-glossus, and superior and middle constrictor muscles. The last-named muscles obtain their filaments through the medium of the pharyngeal plexus. Its sympathetic filaments go to the carotid plexus, and thus connect with the superior cervical ganglion. The tympanic branch, or Jacobson's, enters a small foramen between the jugular foramen and foramen caroticum to go to the tympanum. This branch is noticed more particularly in connection with the ear. Its anastomotic branch to the facial winds round the styloid process, and joins that nerve just as it emerges from the stylo-mastoid foramen. It also sends filaments to the tonsils and palatine arches, forming the tonsillitic plexus.

The Hypoglossal, or the ninth nerve, supplies the muscles of the tongue and larynx with voluntary motor filaments. It enters the neck through the anterior condyloid foramen; just below which it is connected by filaments with the loop formed by the first and second cervical nerves, with the sympathetic by a small filament which comes from the superior cervical ganglion, and also with the pneumo-

gastric. It anastomoses with the gustatory branch of the fifth in the submaxillary region, just before it passes beneath the mylo-hyoideus. The course of this nerve in the carotid and submaxillary regions, with the descendens noni and its other branches given off in these regions, has been described. In the parotid region it lies at first between the internal carotid and internal jugular, and behind the pneumogastric. As it descends, it gets on the outside of the pneumogastric, then in front of it, to turn inwards across the neck, and towards the tongue.

The SPINAL ACCESSORY leaves the cranial cavity with the glosso-pharyngeal and pneumogastric, passing through the foramen lacerum posterius with the latter. Just below the foramen it sends a large branch to join the pneumogastric, thus supplying this nerve with involuntary motor filaments. It also communicates with the sympathetic and ninth nerves. The main trunk descends, usually behind the jugular vein and the styloid muscles, to perforate the sterno-cleido-mastoideus, or to send a branch to it, and then to pass on to the trapezius. Behind the sterno-cleido-mastoid it anastomoses with the cervical plexus.

The PNEUMOGASTRIC, or PAR VAGUM, is the largest division of the eighth nerve. It passes through the foramen lacerum posterius in the same fibrous canal with the spinal accessory. There is a small *ganglion* situated on it in the foramen, and below the foramen it presents a *gangliform* arrangement of about an inch in length. It here lies between the carotid and the jugular vein. It gives off several communicating branches. From the superior ganglion filaments connect with the glosso-pharyngeal and spinal accessory; while from the inferior ganglion filaments communicate with the hypoglossal, the upper spinal, and the sympathetic nerves.

The *auricular branch* of the pneumogastric leaves the superior ganglion, and after giving a small branch to Jacobson's branch of the glosso-pharyngeal, enters the petrous portion of the temporal bone in the jugular fossa, and joins the facial nerve in its bony canal, sending filaments also to the integument around the meatus externus.

The *pharyngeal branch* arises just below the foramen, sometimes receiving a branch from the spinal accessory, and

occasionally from the glosso-pharyngeal, and passes beneath the internal carotid to join, on the side of the pharynx, filaments from the glosso-pharyngeal, superior laryngeal, and superior cervical ganglion, to form the pharyngeal plexus.

The *superior laryngeal* has its origin generally from the inferior ganglion near its middle. It is considerably larger than the preceding branch. It passes downwards and inwards beneath the internal carotid, giving off in its course filaments to the superior cervical ganglion, to the hypoglossal and pharyngeal plexus. It divides into an external and internal branch. The former is the smallest; it is distributed to the external muscles of the larynx, to the thyroid gland, and anastomoses with the recurrent laryngeal, and cardiac branches of the sympathetic. The internal branch passes beneath the thyro-hyoid muscle, and perforates the thyro-hyoid membrane, to be distributed to the mucous membrane of the larynx. This is the sensor nerve of the larynx.

The course of the pneumogastric nerve through the carotid regions and the recurrent branch, have already been described. Just before it enters the thorax it sends off branches to the heart; they unite with branches of the sympathetic, to form the anterior cardiac plexus.

The Sympathetic Nerve traverses the neck from the base of the cranium to the thorax. It presents three cervical ganglia, a superior, middle, and inferior. The number, however, is subject to variation; there being sometimes but two, and again there may be four. When three are present, the superior is situated in front of the second cervical vertebra; the middle opposite to the fifth, and the inferior corresponds to the seventh vertebra.

The *superior ganglion* is usually about an inch in length; its lower extremity is commonly larger than the upper, sometimes it is bifid, and it may taper as it descends in the neck, below the second vertebra, which sometimes occurs. This ganglion connects above by filaments which ascend into the carotid canal, with the carotid plexus, and through this plexus with several of the cranial ganglia. Externally, it communicates with the four superior cervical nerves, by filaments which can be traced into the inter-vertebral foramina. Internally, it is connected by branches with the pharyngeal and laryn-

geal branches of the pneumogastric and the pharyngeal branches of the glosso-pharyngeal. The pharyngeal branches contribute to form the plexus which supplies the pharynx and fauces; the laryngeal join the superior laryngeal nerve. Anteriorly, it gives off branches to join the eighth and ninth nerves, and to go to the external carotid, from which filaments proceed to accompany its different branches. These filaments have been called, from their soft texture, "*nervi molles*."

The *superior cardiac nerve* arises from the inner side of the ganglion, by one or more filaments, descends behind the carotid and alongside of the trachea, and, passing in front of the inferior thyroid artery, enters the thorax in company with the arteria innominata. In its course down the neck it communicates with the pneumogastric and its laryngeal branches, also with the middle and inferior ganglia.

The *middle ganglion* sends branches to one or two of the cervical nerves, and to the pneumogastric. The *middle cardiac nerve* arises from this ganglion when it is present. It pursues a course similar to the superior cardiac nerve. It communicates with the recurrent laryngeal and superior cardiac.

The *inferior ganglion* is dissected more satisfactorily in connection with the thoracic division of the sympathetic. The student must be prepared to meet with numerous variations in the arrangement of the sympathetic nerve. It is impossible to give a description of it which will correspond exactly with any two dissections. But a general knowledge of the numerous connections of this nerve is essential to a correct idea of its functions, and the influence it may exert in various pathological conditions of the body.

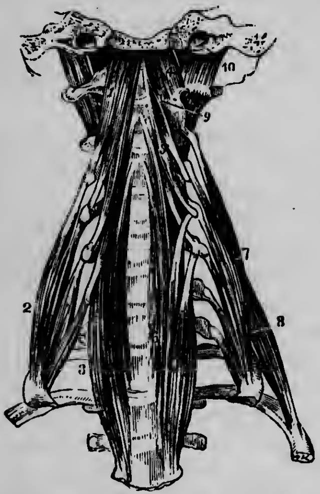
The muscles which may now be examined, are the following:—

The Rectus Anticus Major, Fig. 71 (1), *arises* from the transverse processes of the third, fourth, fifth, and sixth cervical vertebræ, passes upwards and is *inserted* into the cuneiform process of the occipital bone in front of the foramen magnum. It presents a tendinous intersection, which gives attachment to many of its muscular fibres.

Rectus Anticus Minor, Fig. 71 (4), *arises* from the transverse process of the atlas, and is *inserted* into the cuneiform

process of the occipital bone. It covers, in front, the articulation between the atlas and occiput.

Fig. 71.



THE PRÆVERTEBRAL GROUP OF MUSCLES OF THE NECK.—1. The rectus anticus major muscle. 2. The scalenus anticus. 3. The lower part of the longus colli of the right side; it is concealed superiorly by the rectus anticus major. 4. The rectus anticus minor. 5. The upper portion of the longus colli muscle. 6. Its lower portion; the figure rests upon the seventh cervical vertebra. 7. The scalenus medius. 8. Scalenus posticus. 9. One of the intertransversales muscles. 10. The rectus lateralis of the left side.

The RECTUS CAPITIS LATERALIS, Fig. 71 (10), *arises* from the transverse process of the atlas, and is *inserted* into the jugular eminence, on the occipital bone. It separates the jugular vein in front from the vertebral artery behind. The action of the recti muscles is to support the head, or to bend it slightly forwards or laterally.

The LONGUS COLLI, Fig. 71 (5, 6), consists of three portions. The *first arises* from the central and anterior tubercle of the atlas, and passes down to be *inserted* into the transverse processes of the third, fourth, and fifth cervical vertebræ. The *second arises* from the transverse processes of the third and fourth cervical vertebræ, and goes down to be *attached* to the bodies of the upper three dorsal vertebræ. The *third arises* from the second and third cervical vertebræ, and passes down to be *inserted* into the bodies of the lower four cervical and upper three dorsal vertebræ. This muscle supports the vertebral column.

From the experience acquired in the dissection of one side, the student will be able to go over the same ground the second time with more satisfaction to himself. If some things have escaped his attention, or he has failed to obtain a distinct and correct view of them in his first dissection, he will have the opportunity of remedying these defects in his second. And he cannot acquire too great familiarity with any of the

parts, even if he should find it convenient to examine them repeatedly. His attention in the second dissection of the same parts should be directed more particularly to relational anatomy. The following are some of the points especially deserving of his notice: The operations of laryngotomy, tracheotomy, pharyngotomy, and œsophagotomy; the parts to be cut through, and those to be avoided in these operations; also the parts which are liable to be divided in attempts to commit suicide by cutting the throat.

The young physician is liable to be called upon to treat these wounds without being allowed time to consult his books, and consequently he should make himself thoroughly acquainted, when he has the opportunity, with the exact location and the relations of all the parts liable to be implicated in such injuries. The application of ligatures to the various arteries of the neck, and the anastomotic connections between them; also the manner in which the circulation will be carried on when any particular artery is obliterated. The formation of tumors, and the effect they will be likely to have on the surrounding parts, whether those parts be vessels and nerves or the windpipe, the œsophagus, &c.

In dissecting the left side, some *peculiarities* will be met with which do not occur on the right side. These are located in the lower part of the neck. They are introduced separately instead of alluding to them in connection with the description of the right side, as it was thought this method would be less likely to cause embarrassment, especially to the beginner.

The LEFT or GREAT THORACIC DUCT enters the neck behind and internal to the subclavian artery, opposite to the sixth or seventh cervical vertebra; gets behind the internal jugular, and curves outwards, forwards, and downwards to open into the junction of the internal jugular and subclavian veins. If it be not injected, the student may have some difficulty in distinguishing it from the surrounding tissues. It is easily found, however, in the abdomen; and, by inserting a blowpipe into it there, it may be filled with air, when it will swell up and be readily observed in the neck. It varies in its mode of termination; somtimes it opens by two trunks, one into the jugular and the other into the subclavian; or it may open singly into either one of these veins.

It may divide into two trunks in the thorax, and while one opens in the usual place on the left side, the other may open into the right subclavian along with the common lymphatic duct of the right side.

The SUBCLAVIAN ARTERY on the left side arises from the aorta, and consequently is longer than the one on the right side. The second and third divisions have the same relations as on the right side, but with the first or inner section it is quite different. Its direction is nearly vertical, and it makes, in passing behind the scalenus anticus, a much shorter turn. It is covered anteriorly by the same parts, although it is deeper seated. The pneumogastric does not pass over it, nor does the inferior laryngeal or recurrent nerve wind around its posterior surface. It is also in relation with the thoracic duct.

The COMMON CAROTID arises from the aorta, and therefore is longer than the right. It is nearer to the internal jugular and the œsophagus, and is also in relation to the thoracic duct. Its connections in the thorax will be mentioned when that cavity is examined.

The INTERNAL JUGULAR VEIN on the left side requires no special notice. The pneumogastric nerve does not, as before mentioned, pass in front of the subclavian artery as on the right side; nor does it give off the recurrent branch until it has reached the arch of the aorta.

The œsophagus projects a little more on the left side than on the right, and hence it is advised that when it is necessary to open it that it should be done on this side.

SECT. III.—DISSECTION OF THE LARYNX.

The larynx is situated in the upper and anterior part of the neck, in front of the pharynx and above the trachea. It presents a regular framework, which is composed of several fibro-cartilages joined together by ligaments. It is supplied with muscles, vessels, nerves, and mucous membrane. Its structure is such that it remains constantly patulous, while the mobility of its cartilages adapts it to the production of the voice. For the purposes of respiration merely, a very

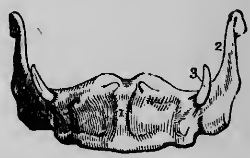
simple arrangement would have been sufficient, as in the case of the trachea and bronchial tubes. To make a thorough examination of this organ, the student should be provided with at least two larynges; one for the dissection of the cartilages and ligaments, and another for the muscles, vessels, and nerves.

The HYOID BONE should be examined before the dissection of the cartilages and ligaments of the larynx. It is situated between the base of the tongue and the upper part of the larynx, and is connected to both of these organs. It is named from its having a form resembling the Greek letter upsilon. Its position is nearly horizontal, being concave posteriorly and convex anteriorly.

It consists of a central part or body, and four lateral portions called cornua. There are two cornua on each side, one large and one small.

The *Body*, Fig. 72 (1), is curved and flattened. It presents a superior anterior, and inferior posterior surface. The anterior superior surface is rough and uneven for the attachment of muscles. The inferior posterior surface is excavated, and sometimes occupied by a yellow areolar tissue. Its upper border gives attachment to the hyo-glossal membrane or septum of the tongue. The thyro-hyoid muscle is inserted into its inferior border.

Fig. 72.



AN ANTERIOR VIEW OF THE OS HYOIDES.—1. The anterior convex side of the body. 2. The cornu majus of the left side. 3. The cornu minus of the same side. The cornua were ossified to the body of the bone in this specimen.

The *Great Cornua*, Fig. 72 (2), proceed backwards from the ends of the body, and, diminishing in size, terminate in tubercles. In the young bone, they are connected to the body by cartilage. They present a superior and an inferior surface.

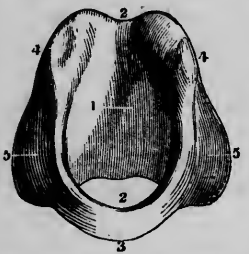
The *Small Cornua*, Fig. 72 (3), are two small bodies which project upwards from the junction of the body with the great cornua. The stylo-hyoid ligaments are inserted into them. These ligaments are sometimes found ossified.

The principal cartilages are the cricoid, the thyroid, the

two arytenoid, and the epiglottis. Besides these, there are four small bodies, two of which are named the appendices, and two the cuneiform bodies.

The Cricoid Cartilage, Fig. 73, is situated in the lower part of the larynx, and seems to belong partly to the larynx and partly to the trachea. It consists of a ring slightly elliptical, its transverse diameter being less than its antero-posterior. Its lower border is horizontal, and corresponds to the first ring of the trachea. Its upper border is oblique from before backwards and upwards, making its vertical diameter about four times greater behind than before. It has four articular facets, two for the thyroid cartilage and one for each of the arytenoid. The former are situated on its external surface, behind the centre and near the lower margin. The latter are on its upper border behind, and about one-fourth of an inch apart; they are convex and sloping laterally, being adapted to the articular facets on the bases of the arytenoid cartilages. Its antero-lateral surface is convex, and is principally occupied by the crico-thyroid muscle. On its posterior surface are observed two depressions, which give attachment to the crico-arytenoidei postici muscles. These depressions are separated by a vertical ridge, to which are attached some of the longitudinal muscular fibres of the œsophagus. Its internal surface is smooth and covered by mucous membrane.

Fig. 73.

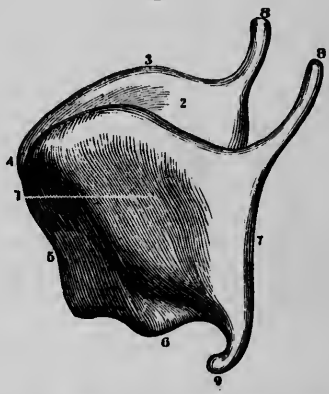


A Front View of the Cricoid Cartilage.—1. Its internal face. 2. The cavity of the larynx as formed by this cartilage. 3. Its inferior surface. 4, 4. The little heads or convexities for articulating with the arytenoids. 5, 5. The surface of the superior edge for the attachment of the lateral crico-arytenoid muscles.

The Thyroid Cartilage, Fig. 74, forms the upper, anterior, and lateral parts of the larynx. It consists of two plates or alæ, which are joined at the median line in front, and separated behind nearly three-fourths of an inch. The angle formed by the junction of the alæ anteriorly is more prominent above than below, and more in the male than in the female. It forms what is called the "pomum Adami." On the external surface of each ala are two tubercles connected by

an oblique ridge. The lower tubercle is situated anteriorly and near the inferior border, while the upper one is placed posteriorly and near the superior border. The surface above and anterior to the oblique ridge is much larger than the one below and behind it. The latter is occupied by the sterno-thyroid, and the former by the thyro-hyoid muscle. The inferior border of each ala terminates behind in a projection downwards, called the inferior or small cornu. It articulates with the cricoid cartilage. Just before the small cornu on each side is quite a deep notch; there is also another one, but not so deep in front. The upper border of each ala terminates posteriorly in a much longer projection, called the superior or great cornu; this is inclined backwards, and gives attachment to the lateral thyro-hyoid ligament. Anteriorly there is quite a deep notch, which can be distinctly felt in the living body. The posterior borders of the alæ are thick and round for the attachment of the fibres of the inferior constrictor of the pharynx.

Fig. 74.

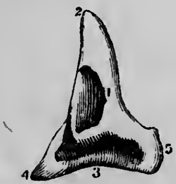


A LATERAL VIEW OF THE THYROID CARTILAGE.—1. Its left half. 2. Its right half. 3. The superior margin. 4. The notch. 5. Anterior angle. 6. Inferior margin. 7. Posterior margin. 8, 8. Cornu majus of each side. 9. Cornu minus.

The ARYTENOID CARTILAGES, Figs. 75, 76, are situated behind, upon the cricoid, and between the alæ of the thyroid. They are of a pyramidal form. The posterior surface of each is concave, and occupied by the arytenoid muscle. The anterior surface is convex, with a slight elevation near the apex for the attachment of the superior vocal chord. The internal surface is flat and smooth. The base projects anteriorly nearly one-third of the way across the interior of the larynx, and gives insertion to the inferior vocal chord. It also projects posteriorly and externally for the attachment of the crico-arytenoideus posticus muscle. The articular surface on

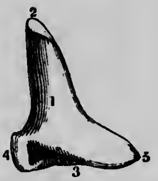
the base is concave, and adapted to the corresponding articular surface on the cricoid cartilage. The arytenoid cartilages belong essentially to the vocal chords, and as such should be

Fig. 75.



An Anterior View of the Left Arytenoid Cartilage.—1. Its anterior face. The other references as in Fig. 76.

Fig. 76.



A Posterior View of the Left Arytenoid Cartilage.—1. Its posterior face. 2. The summit. 3. The base and cavity for articulating with the cricoid cartilage. 4. Its external angle. 5. Its internal angle.

studied. They can be moved in an outward, inward, backward, and forward direction, and also allow to some extent of a spiral movement. By means of these movements the vocal chords can be made tense or relaxed, and the size of the fissure between them, called the rima glottidis, can be increased or diminished in width.

Fig. 77.

A Lateral View of the Epiglottis.—1. Anterior or convex surface. 2. Posterior or concave surface. 3. Superior margin. 4. Inferior margin or pedicle. 5, 5. Its sides. The openings of the muciparous ducts are also shown.

The Appendices are two small bodies surmounting the apices of the arytenoid cartilages. They are inclined backwards and towards each other, lengthening the curvature of these cartilages in this direction, and at the same time increasing their vertical diameter.

The Epiglottis, Fig. 77, is generally spoken of as a fibro-cartilage, although its structure seems to be peculiar to itself. It is of an oval form. Its posterior surface is concave transversely, and convex vertically; its anterior surface is just the reverse. The upper part of its anterior surface is free, and covered by mucous membrane, while the lower part is attached to the tongue, os hyoides, and thyroid cartilage. It is con-

nected to the tongue by yellow elastic tissue, to the body of the os hyoides by ligamentous fibres, and also to the thyroid cartilage just above the anterior insertion of the vocal chords. Between the two latter attachments is found a mass of celluloadipose tissue, of a yellowish color, and surrounded by areolar tissue; it has been called the "epiglottic gland," but without any good reason, as it is destitute of all the elements of a true gland. On the posterior surface of the epiglottis are observed numerous small foramina, orifices of mucous follicles. It is of a yellowish color, and very flexible and elastic, being easily depressed so as to meet the glottis in the ascent of the larynx, by the passage of food from the fauces into the pharynx, immediately recovering its vertical position when the pressure is removed. It is never found ossified, like the other cartilages of the larynx.

The *cuneiform bodies* are two small masses, found in the aryteno-epiglottidean folds of the mucous membrane, a short distance above the appendices or cornicula. Sometimes they are very indistinct, and possess very little firmness.

The ligaments connecting the cartilages of the larynx to each other, and to the hyoid bone, are the following:—

The thyroid cartilage is connected to the os hyoides by a middle and two lateral ligaments.

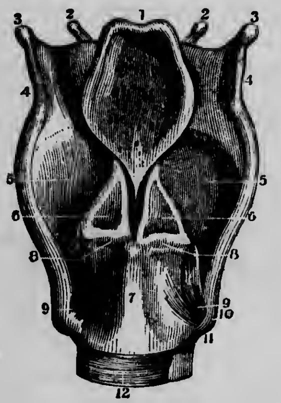
The MIDDLE THYRO-HYOID, Fig. 79 (4), is a broad, yellow ligament, extending from the centre of the upper border of the thyroid to the posterior part of the body of the os hyoides. The LATERAL, Fig. 78 (4, 4), are round, fibrous cords, connecting the superior cornua of the thyroid to the extremities of the great cornua of the os hyoides. The spaces between these ligaments are occupied by dense areolar tissue. The ligamentous attachments of the epiglottis have been spoken of in connection with that body.

The cricoid cartilage is joined to the thyroid by three ligaments, two lateral, and one middle.

The LATERAL LIGAMENTS, Fig. 78 (9, 9), are regular capsular ligaments, containing, in each, a synovial sac. These articulations allow of a gliding and rotary movement. The MIDDLE CRICO-THYROID, Fig. 79 (10), is of the yellow elastic tissue, connecting the anterior part of the upper border of the cricoid with the corresponding portion of the lower margin of the thyroid. It is perforated by one or more foramina, for

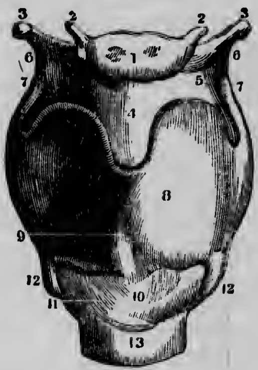
the transmission of vessels. It serves to keep the thyroid in its proper position, without interfering with its necessary

Fig. 78.



A Posterior View of the Articulations of the Cartilages of the Larynx.—1. Posterior face of the epiglottis. 2, 2. Appendices of the os hyoides. 3, 3. Its cornua. 4, 4. Lateral thyro-hyoid ligaments. 5. Posterior face of the thyroid cartilage. 6, 6. Arytenoid cartilages. 7. Cricoid cartilage. 8, 8. Crico-arytenoid articulations. 9, 9. Lateral crico-thyroid ligaments. 10. Cornu minus of the thyroid cartilage. 11. Middle crico-thyroid ligament. 12. Ligamentous portion of the first ring of the trachea.

Fig. 79.



A Front View of the Ligaments of the Larynx.—1. Body of the os hyoides. 2, 2. Its appendices. 3, 3. Its cornua. 4, 5. Middle thyro-hyoid ligament. 6, 6. Lateral thyro-hyoid ligaments. 7. Cornu majus of each half of the thyroid cartilage. 8. Side of the thyroid cartilage. 9. Its projecting angle. 10. Middle crico-thyroid ligament. 11. Crico-thyroid membrane. 12. Cornu minus of each side of the thyroid cartilage. 13. First ring of the trachea.

movements. Between the middle and lateral ligaments, these cartilages are connected by quite a dense structure, called the *crico-thyroid membrane*, Fig. 79 (11).

The cricoid and arytenoid are connected by TWO CAPSULAR LIGAMENTS, Fig. 78 (8, 8), which contain synovial membranes. These articulations allow of very free movement to the arytenoid cartilages.

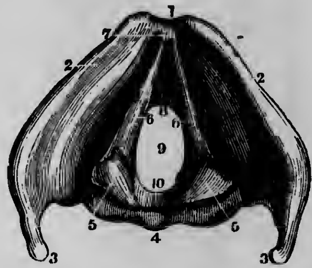
The CHORDÆ VOCALES, or THYRO-ARYTENOID LIGAMENTS, Fig. 81 (6, 6), consist of two on each side, one above the other. The inferior are sometimes called the true vocal ligaments, on account of their containing much more fibrous structure than the superior. They are composed of the yellow elastic

tissue. The inferior are horizontal, while the superior are slightly arched upwards and outwards. They arise from

Fig. 80.

A LATERAL VIEW OF THE SAME.—1. Os hyoides. 2. Thyro-hyoid membrane. 3. Cornu majus of the thyroid cartilage. 4. Its angle and side. 5. Cornu minus. 6. Lateral portion of the cricoid cartilage. 7. Rings of the trachea.

Fig. 81.



A VIEW OF THE LARYNX FROM ABOVE, SHOWING THE THYRO-ARYTENOID OR VOCAL LIGAMENTS.—1. Superior edge of the larynx. 2. Its internal face. 3. Cornua majora of the thyroid cartilage. 4. Posterior face of the cricoid cartilage. 5, 5. Arytenoid cartilages. 6, 6. Thyro-arytenoid ligaments. 7. Their origin within the angle of the thyroid cartilage. 8. Their terminations at the bases of arytenoid cartilages. 9. The glottis. 10. Anterior part of the inferior surface of the cricoid cartilages.

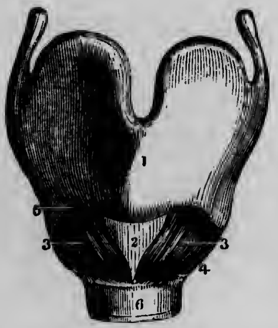
the angle of the thyroid cartilage, close to each other, and are inserted, the inferior into the anterior processes at the bases of the arytenoids, and the superior near their apices. They diverge somewhat as they proceed backwards, giving to the rima glottidis the shape of the letter V, with the angle pointing forwards. The inferior are covered by mucous membrane on their inner and upper surfaces, while the superior are covered on their inner, lower, and external surfaces.

The muscles of the larynx are small, and generally named from the parts to which they are attached. The thyro-hyoideus was described with the muscles of the neck.

The CRICO-THYROIDEUS, Fig. 82 (3), is quite short, and of a triangular shape. It *arises* from the anterior part of the cricoid cartilage, by a narrow point, and passes upwards and outwards to be *inserted* into the thyroid cartilage, occupying

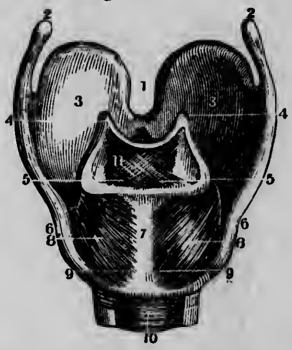
the outer part of its lower border and inferior cornu. The two thyro-hyoidei muscles leave a triangular space between them, in which the middle crico-thyroid ligament is situated.

Fig. 82.



A FRONT VIEW OF THE CRICO-THYROID MUSCLES.—1. Thyroid cartilage. 2. Crico-thyroid ligament. 3, 3. Crico-thyroid muscles. 4. Origin of left. 5. Insertion of right. 6. First ring of the trachea.

Fig. 83.



A POSTERIOR VIEW OF THE ARYTENOID AND CRICO-ARYTENOID MUSCLES. —1, 2, 3. Thyroid cartilage. 4, 4. Summits of the arytenoid cartilages. 5, 5. Insertions of arytenoid muscles. 6, 6. Cricoid cartilage. 7. Its middle portion. 8, 9, 8, 9. Posterior crico-arytenoid muscles. 10. Posterior portion of the trachea. 11. Arytenoid muscles.

The CRICO-ARYTENOIDEUS POSTICUS, Fig. 83 (8), *arises* from the posterior surface of the cricoid cartilage, passes obliquely upwards and outwards to be *inserted* into a process on the posterior and outer side of the base of the arytenoid cartilage.

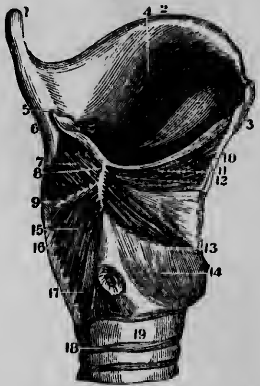
The ARYTENOIDEUS, Fig. 83 (11), consists of transverse and oblique fibres. The *latter* are superficial, and extend from the base of one cartilage to the apex of the other. The *former* pass from the posterior surface of one cartilage to that of the other. The last-named muscles are exposed by simply removing the mucous membrane and some areolar tissue which covers them posteriorly.

The THYRO-EPIGLOTTICI and ARYTENO-EPIGLOTTICI, are composed of a few pale, muscular fibres, passing, the former from the thyroid, and the latter from the arytenoid cartilages to the epiglottis, within the folds of mucous mem-

brane which extend between these cartilages. They are more strongly developed in the larynx of some of the lower animals.

The THYRO-ARYTENOIDEUS, Fig. 84 (11), is situated between the ala of the thyroid cartilage, and the vocal chords and ventricle of the larynx. To expose this muscle, it is necessary to remove the posterior part of one of the alæ of the thyroid cartilage, by dividing it vertically a short distance behind the median line, and disarticulating it from the cricoid. It is separated from the cartilage by some loose areolar tissue, which must be carefully dissected away.

Fig. 84.



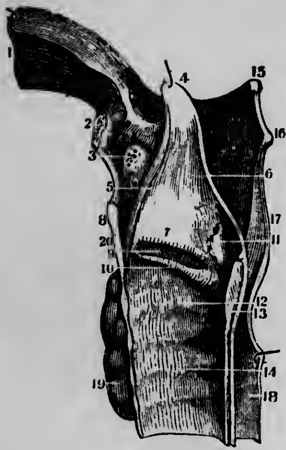
A VERTICAL SECTION OF THE LARYNX TO SHOW SOME OF ITS MUSCLES.—1. Cornu majus of the thyroid cartilage. 2. Its superior border. 3. Section of its body. 4. Its internal surface. 5. Arytenoid cartilage. 6. Posterior surface of the thyroid cartilage. 7, 8, 9. Arytenoid muscles. 10, 11, 12. Thyro-arytenoid muscle. 13. Crico-arytenoideus lateralis muscle. 14. Cricoid cartilage. 15, 16, 17. Crico-arytenoideus posticus. 18, 19. First rings of the trachea as united by ligament.

The CRICO-ARYTENOIDEUS LATERALIS, Fig. 84 (13), may be exposed by the same dissection. It *arises* from the upper border of the cricoid cartilage, just on the inside of the surface on which rests the ala of the thyroid cartilage, and passes obliquely backwards to be *inserted* into the base of the arytenoid.

The MUCOUS MEMBRANE of the larynx is continuous through its superior orifice with that of the pharynx, and, through its lower opening, with that of the trachea. It follows all its elevations and depressions. The lateral boundaries of the glottis are formed by folds of this membrane, which extend from the arytenoid cartilages obliquely upwards and forwards to the sides of the epiglottis, thus leaving an opening between them of a triangular shape, with the base formed by the epiglottis. There are quite a number of mucous glands in the larynx, especially about the ventricles and glottis.

The VENTRICLES, Fig. 85 (9), of the larynx are two pouches, one situated on each side of the rima glottidis, and lined

Fig. 85.



A VERTICAL SECTION OF THE LARYNX, TO SHOW ITS INTERNAL SURFACE.—1. Section of tho root of the tongue. 2. Os hyoides. 3. The muciparous gland of the epiglottis. 4. Top of the epiglottic cartilage. 5. A section of its anterior face. 6. A fold of mucous membrane from tho arytenoids to the epiglottis. 7. Superior vocal ligament. 8. Section of thyroid cartilage. 9. Vontricle of Galen or Morgagni. 10. Lower vocal ligament. 11. Arytenoid cartilage. 12. Inside of the cricoid cartilage. 13. Its posterior portion. 14. Lining membrane of the trachea. 15. End of the cornu majus of the os hyoides. 16. Cornu majus of the thyroid cartilage. 17. Mucous membrane of the pharynx. 18. Œsophagus. 19. Thyroid gland.

by mucous membrane. Each of them is placed between the vocal chords of its own side, especially the superior, on the inside, and the thyro-arytenoid muscle on the outside. The *sacculus laryngis* is a projection of the ventricle upwards on the outside of the superior cord. Several mucous glands are found in these pouches, and which are pressed upon by the thyro-arytenoid muscles.

The RIMA GLOTTIDIS is the space between the vocal chords of the two sides. Its form was spoken of in connection with the chords. This orifice and the glottis are subject to variations in size, but the inferior, or tracheal, opening of the larynx remains constantly the same, being surrounded by the cricoid cartilage.

There is, beneath the mucous membrane around the glottis, an abundance of loose areolar tissue. In inflammation of these parts, serum is effused in this areolar tissue; sometimes in sufficient quantity to cause great difficulty in respiration, or even death.

The *arteries* of the larynx are derived from the superior and inferior thyroid; and it is abundantly supplied from these sources with arterial blood.

The *veins* terminate in those in the immediate vicinity.

Its *nerves* are the superior and inferior laryngeal branches of the pneumogastric, and a branch of the hypoglossal. The *superior laryngeal* enters the larynx either just above the thyroid cartilage, or through a foramen in this cartilage. It is distributed principally to the mucous membrane, although it sends some filaments to the muscles. The *inferior laryngeal*,

or *recurrent branch*, enters the larynx at its lower and posterior part. It supplies, mainly, the muscles with involuntary motor filaments. The *hypoglossal branch* furnishes the laryngeal muscles with voluntary motor filaments.

SECT. IV.—DISSECTION OF THE PHARYNX.

The pharynx should be distended with hair, or something which may be had conveniently, for the dissection of its muscles. It is reached with more facility if the cervical vertebræ be first removed, or if a transverse vertical section of the cranium be made just in front of the occipital foramen. If the student has an opportunity to dissect but a single subject, he should not sacrifice a good view of the topography of the interior of the pharynx, for the sake of getting a more distinct idea of its muscles by a special dissection.

The following are the five muscles which enter more or less into the composition of its muscular walls:—

The INFERIOR CONSTRICTOR, Fig. 86 (7), and Fig. 87 (9), *arises* from the upper ring of the trachea, the cricoid cartilage, and the posterior part of the ala of the thyroid; the fibres radiate as they pass backwards to be *inserted* into the raphé, which is common to the constrictors of both sides. The lower fibres are nearly horizontal in their direction, and correspond to the superior circular fibres of the œsophagus. The superior fibres are oblique, and overlap the lower part of the middle constrictor.

The MIDDLE CONSTRICTOR, Fig. 86 (6), *arises* from the cornua of the hyoid bone, and from the stylo-hyoid ligament; its fibres radiate backwards, and are *inserted* into the raphé. The upper fibres overlap the lower portion of the superior constrictor, from which they are separated by the stylo-pharyngeus muscle, and the glosso-pharyngeal nerve. It is connected to the base of the skull by the pharyngeal aponeurosis.

The SUPERIOR CONSTRICTOR, Fig. 86 (5), *arises* from several points, as the internal pterygoid plate, the pterygo-maxillary ligament, and the mylo-hyoid ridge of the inferior maxilla. Its fibres pass backwards to be *inserted* into the raphé, and also to be connected with the pharyngeal aponeu-

rosis. There is quite a space between its upper border on each side, and the base of the cranium, which is occupied by the pharyngeal aponeurosis.

The STYLO-PHARYNGEUS, Fig. 86 (11), as its name implies, *extends* from the styloid process to the pharynx. Its fibres

Fig. 86.

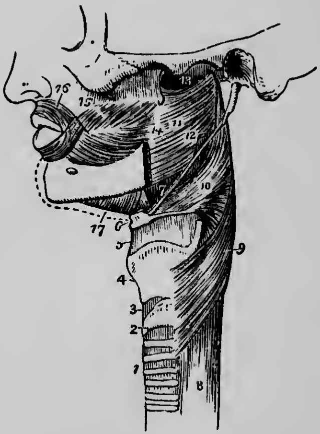
A POSTERIOR VIEW OF THE MUSCLES OF THE EXTERNAL PORTION OF THE PHARYNX, AS SHOWN BY REMOVING THE BACK OF THE HEAD AND THORAX.—1. Basilar portion of the sphenoid bone. 2. Inferior anterior portion of the os frontis, and crista Galli of the ethmoid. 3, 3. Petrous portions of temporal bones. 4. Levator palati muscle. 5. Constrictor pharyngis superior. 6. Constrictor pharyngis medius. 7. Constrictor pharyngis inferior. 8. Upper part of posterior face of the lining membrane of pharynx, after removing the muscle. 9. Longitudinal muscular fibres of the œsophagus. 10. Internal pterygoid muscle. 11. Stylo-pharyngeus. 12. Myloid attachment of the constrictor pharyngeus superior. 13. Stylo-hyoideus. 14. Temporal belly of digastricus. 15. Platysma myoides muscle. 16. Sterno-cleido-mastoideus. 17. Omo-hyoideus. 18. Sterno-thyroid muscle. 19. Sterno-hyoid. 20. Section of sterno-thyroideus. 21. Section of the trapezius muscle.

enter the pharynx between the superior and middle constrictors, some of them to be *inserted* into the posterior border of the thyroid cartilage, and others to be lost in the pharynx.

The PALATO-PHARYNGEUS belongs partly to the soft palate, and partly to the pharynx. It arises from the posterior

border of the ala of the thyroid cartilage, passes upwards to form the posterior half-arch of the palate, and then spreads out to be inserted into the median line of the palate, with its fellow on the opposite side.

Fig. 87.



A SIDE VIEW OF THE MUSCLES OF THE PHARYNX.—1. The trachea. 2. The cricoid cartilage. 3. The crico-thyroid membrane. 4. The thyroid cartilage. 5. The thyro-hyoidean membrane. 6. The os hyoides. 7. The stylo-hyoidean ligament. 8. The œsophagus. 9. The inferior constrictor. 10. The middle constrictor. 11. The superior constrictor. 12. The stylo-pharyngeus muscle passing down between the superior and middle constrictor. 13. The upper concave border of the superior constrictor; at this point the muscular fibres of the pharynx are deficient. 14. The pterygo-maxillary ligament. 15. The buccinator muscle. 16. The orbicularis oris. 17. The mylo-hyoideus.

The PHARYNGEAL APONEUROSIS is thick and strong at the upper part of the pharynx, where it serves to connect its muscular walls to the base of the cranium, and to complete them in this part of it. As it descends, it gradually becomes thinner, until it ends in areolar tissue. It is situated between the mucous membrane and muscular layer.

The *arteries* of the pharynx are obtained principally from the ascending pharyngeal; it also receives small branches from the superior thyroid, the palatine and the pharyngeal branches of the internal maxillary.

The *nerves* come from the pharyngeal plexus, which consists of sensor and involuntary motor filaments derived from the glosso-pharyngeal, pneumogastric, and sympathetic.

The pharynx is separated from the vertebræ by the longus colli and rectus capitis anticus major muscles.

The anatomy of the trachea and œsophagus will be described, the former in connection with the bronchi and lungs, and the latter with the contents of the mediastinum.

PART II.

DISSECTION OF THORAX, BACK, AND UPPER EXTREMITY.

CHAPTER I.

THE UPPER EXTREMITY.

SECT. I.—DISSECTION OF THE PECTORAL AND AXILLARY REGIONS.

BEFORE commencing the dissection of these parts, the student should make himself familiar with the prominent points around the shoulder and axilla. He should also notice the outlines of the thorax, the regions into which it is divided for the purposes of auscultation and percussion, the position of the mammæ, and the degree in which these various regions are subcutaneous or covered by muscles.

It will be perceived that the sternum is partly subcutaneous, also the clavicle, with the acromion process, and spine of the scapula. The position of the coracoid process of the scapula should be ascertained, and its relations to the clavicle and acromion process carefully observed. The position of the upper extremity should be varied so as to show the movements of the clavicle and scapula, and any changes which may occur in the general configuration of the parts.

An incision may now be made through the skin and superficial fascia, commencing at the middle of the upper border of the sternum, and extending along the clavicle to the acromion process. Another may then be made along the median line of the sternum, to the xiphoid cartilage; and a third from the sterno-clavicular articulation, to the insertion of the pectoralis major. The skin may now be raised by reflecting one flap towards the shoulder, and the other towards the lower border of the pectoralis major. In case the abdomen is being

dissected at the same time, it may be convenient to carry the last incision from the xiphoid cartilage along the lower border of the pectoral muscle, since the parts belonging to both the upper and lower extremities are here more or less blended. In this way the same incision, as far as the origin of the pectoralis major is concerned, will answer for both. The portion of skin covering the serratus magnus may be left till the student is ready to dissect the axilla, when it may be reflected off in a single flap.

The integument of the pectoral region demands no particular notice.

Its *nerves* are derived partly from the supra-clavicular, Fig. 103 (1), and supra-acromial, Fig. 104 (1), branches of the cervical plexus, which descend from the neck over the clavicle and sternum, and partly from the anterior cutaneous branches of the intercostals, which perforate the intercostal spaces along the border of the sternum, and ramify in the subcutaneous fascia; a branch of the second intercostal nerve anastomoses with a branch of the supra-clavicular.

The *cutaneous arteries* come from the internal mammary, and from the thoracic branches of the axillary. The largest of them are distributed to the mammary gland.

There is only one vein of any importance superficial to the deltoid and pectoralis major muscles, and this is the *cephalic*, which occupies the groove corresponding to the juxtaposition of these muscles. In removing the skin and fascia, the student should look for this vein and the humeral branch of the thoracico-acromial artery which accompanies it.

Fig. 88.

A Side View of the Mammary Gland.

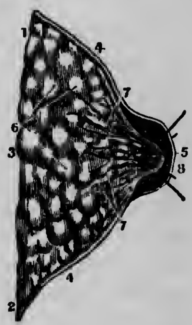
The Mammary Gland, Fig. 88, should be examined *in sitû:* its lobulated arrangement; its appearance as contrasted with the surrounding tissues; the manner in which it is connected with the fascia, and its relations to the pectoralis major and the thorax generally.

Its *arteries* and *nerves* are derived from the same sources as those of the skin in its vicinity. Its *lymphatics* are connected with those

of the axilla, and also with others in the cavity of the thorax.

The size of the gland varies greatly. In the female it is much larger than in the male. The nipple is situated a little to the inner side of the centre. It is surrounded by an areola, the tint of which, in the female, depends on several circumstances, as complexion, menstruation, pregnancy, &c. The surface of the mamma appears smooth, the spaces between the lobules being filled with fat. There is not, however, usually much fat beneath the skin around the nipple.

Fig. 89.



A Vertical Section of the Mammary Gland, showing its Thickness and the Origins of the Lactiferous Ducts.—1, 2, 3. Its pectoral surface. 4. Section of the skin on the surface of the gland. 5. The thin skin covering the nipple. 6. The lobules and lobes composing the gland. 7. The lactiferous tubes coming from the lobules. 8. The same tubes collected in the nipple.

The *lactiferous tubes*, Fig. 89, in the nipple, vary from fifteen to twenty-three or four. These tubes are wholly independent of each other; so, also, are the various smaller ducts of the different lobules, which proceed from the radicles, and unite to form them; hence, if one of these tubes shall become closed during lactation, the milk will necessarily be accumulated in all the smaller tubes of which that is a common outlet.

There are small glands on and around the nipple, for the purpose of supplying a lubricating secretion.

The importance of supporting the mammæ during lactation, and especially if suffering from inflammation, will be suggested by their position and means of attachment to the thorax.

There is generally very little fat in the subcutaneous fascia or areolar tissue in this region.

The *deep* or *special fasciæ* consist of one investing the pectoralis major, and another covering the deltoid. The *pectoral fascia* is continuous from the lower border of the great pectoral muscle, across the axilla to the latissimus dorsi; also with the fascia of the arm. Externally, it dips down between the deltoid and pectoralis major muscles, along with the deltoid fascia, which is inserted below into the deltoid ridge, and is

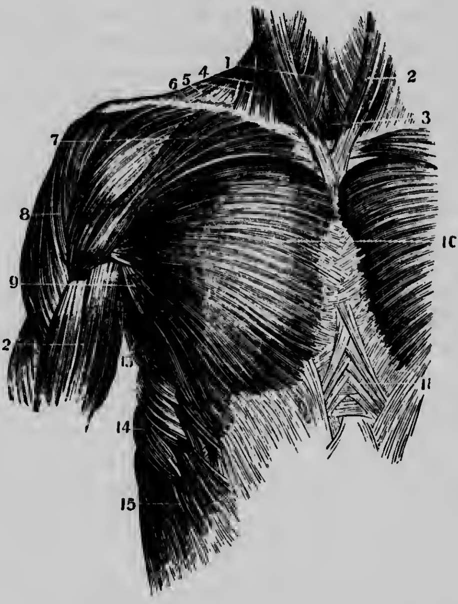
continuous behind with the infra-spinata fascia and that of the arm or the brachial fascia. These fasciæ should be studied with reference more particularly to the formation of abscesses beneath them.

The deep fascia may now be raised by making an incision through it from the sterno-clavicular articulation to the insertion of the pectoralis major. The student, in this way, will be able to raise the fascia so as to trace its continuity as described above, at the same time that he exposes the pectoralis major. The deltoid fascia may be raised in the same manner from the deltoid muscle, although it will be sufficient to expose only the anterior half of this muscle at the present time.

The PECTORALIS MAJOR, Fig. 90 (7, 10), *arises* from the inner half of the clavicle, the anterior surface of the sternum, the cartilages of the second, third, fourth, fifth, and sixth ribs, and by a slip from the aponeurosis of the external oblique. From this broad origin the fibres converge, and are *inserted*, by a flat tendon, into the anterior margin of the bicipital groove on the humerus, and into the brachial fascia. From the extensive origin and narrow insertion of this muscle, the student will see the necessity of the difference which exists in the direction of its fibres, and the effects of different portions of the muscle acting separately. The lower fibres are nearly horizontal, while the upper are vertical in their direction. The upper part of the muscle is inserted lower down than the inferior portion, which causes a sort of doubling of the tendon. The action of this muscle varies; if the clavicular portion alone acts, it will draw the arm upwards and forwards, the sternal will move it directly forwards, while the lower part will draw it downwards and forwards; the entire muscle will bring the arm inwards and forwards. If the humerus be elevated and fixed, then the lower part of the muscle will raise the ribs and draw them outwards so as to assist in expanding the thorax. If the hand be supined, it is capable of pronating it by rotating the humerus inwards. The clavicular portion is usually separated from the costosternal by areolar tissue. This fissure is sometimes quite large, and extends some distance towards the insertion of the muscle; again, it is scarcely perceptible. An areolar interspace also separates this muscle from the deltoid. In this

space are found the *cephalic vein* and the *humeral branch*, Fig. 94, of the thoracico-acromial artery.

Fig. 90.



A View of the Superficial Muscles of the Upper Front of the Trunk.—1. Sterno-hyoid. 2. Sterno-cleido-mastoid. 3. Sterno-thyroid. 4. Clavicular portion of the sterno-cleido-mastoid. 5. Anterior edge of the trapezius. 6. Clavicle. 7. Clavicular origin of the pectoralis major. 8. Deltoid. 9. Fold of fibres of the pectoralis major on the anterior edge of the axilla. 10. Middle of the pectoralis major. 11. The crossing and interlocking of the fibres of the external oblique of one side of the abdomen with those of the other. 12. Biceps flexor cubiti. 13. Teres major. 14. Serratus magnus anticus. 15. Superior heads of the external oblique interlocking with the serratus magnus.

The pectoralis major may now be raised from its origin, taking care to observe the nerves and arteries which penetrate its under surface.

The nerves come from the axillary, and consist of one or two branches, called the *superior thoracic*, Fig. 93. The arteries are branches of the *superior thoracic* and *thoracica acromialis*, Fig. 92, which arise, most frequently, by a common trunk, from the axillary artery. The pectoralis major should be

raised with a view of replacing it so as to study its relations to the axilla.

Instead of detaching the entire muscle from its origin, the student may turn down the clavicular portion at first, and dissect down to the axillary vessels and nerves, which will afford him a good view of the surgical relations of the upper part of the *axillary artery.* In this way, he will be able to obtain a correct idea of its depth, and what parts are necessarily involved in cutting down upon it just below the clavicle. In doing this, the following parts will be seen:—

Having turned the clavicular portion of the pectoralis major down to the extent of about three inches, the *costo-clavicular aponeurosis* will be brought into view. This is attached to the first rib, the clavicle, and the coracoid process, and is reflected downwards over the pectoralis minor.

Coming through this fascia, and close to the upper border of the pectoralis minor, will be observed the *superior thoracic* and *thoracico-acromial arteries*, Fig. 92 (11,12); the first going to the pectoralis major, and the last towards the deltoid muscle, to divide into its acromial, humeral, and thoracic branches. The *acromial* branch is distributed to the parts in the neighborhood of the acromion process; the *humeral* enters the fissure between the deltoid and pectoralis major, to be distributed principally to the former muscle; the *thoracic* branch goes to the latter muscle. These arteries send branches to the skin and fascia crossing the muscles.

The Superior Thoracic Nerve, which arises behind the clavicle, perforates this fascia, and accompanies the artery of the same name to the pectoralis major.

The Cephalic Vein, after passing up in the groove between the deltoid and pectoralis major to near the clavicle, dips beneath the latter muscle, and passes transversely across to terminate in the axillary vein, which lies close to the thorax, Fig. 94. There are other veins in this region which open either into the cephalic, or directly into the axillary, but they are small, and have no practical importance.

Removing the fascia and areolar tissue, the upper border of the *pectoralis minor* below, and the *subclavius muscle*, Fig. 91 (3, 12), above, will be seen separated by a space somewhat triangular in shape. In this space, and occupying a plane deeper than these muscles, are the *axillary vein*, *artery*, and

nerves, Figs. 93, 94. The artery is situated between the vein on its thoracic side, and the nerves on its humeral side. The artery is deeper seated than the vein, and the nerves are situated on a plane deeper than it.

In making this dissection, there is nothing destroyed which the student will have any occasion to examine afterwards; nor is it so complex as to prevent any one from making it, if he will exercise a little patience; and, when finished, he will have the satisfaction of seeing at once how the knowledge which he has acquired can be applied in practice; for he can now tell, from his own observation, which parts would have to be divided, what parts should be avoided, and how deep an incision would be required to reach the axillary artery in the upper part of its course. He has now a picture fixed in his mind, made up of several details, which sustain a certain relation to each other, and all of them to the main object in the whole group or picture. He will not be likely to forget the *special anatomy* of parts when their *surgical relations* are thus fixed in his mind. He sees, for instance, the clavicular portion of the pectoralis major, the manner in which it covers the pectoralis minor and the subclavius, with the space between them; how this space is filled up with a fascia which is perforated by small vessels and nerves; how the great arterial trunk, which is destined to supply nearly the whole of the upper extremity with arterial blood, enters the axilla; how the great venous trunk, which is required to return this blood, leaves the axilla; and how the nerves enter the same space preparatory to dividing and subdividing to go to every part of the upper extremity.

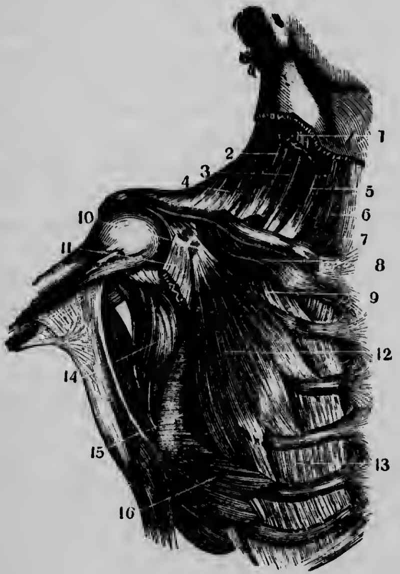
The pectoralis major having been separated from its connections, except its insertion, the *pectoralis minor* now comes into view.

The Pectoralis Minor, Fig. 91 (12), *arises* from the second, third, fourth, and fifth ribs, sometimes from but three, and is *inserted* tendinous, into the coracoid process, near its free extremity. Its tendon is connected with the coraco-brachialis and short head of the biceps, and frequently by a fibrous band with the triangular, or capsular, ligament of the shoulder joint. It forms a part of the anterior wall of the axilla, leaving a space above and below to be formed by the pecto-

ralis major, the fibres of which it crosses nearly at a right angle. By observing its attachments, and the direction of its fibres, it will be seen that it can draw the scapula downwards, forwards, and inwards; or when the shoulder is carried upwards and backwards, and fixed in this position, it can elevate the ribs from which it takes its origin. Thus by placing the arm and shoulder in a proper position, both the pectoral muscles become powerful agents in expanding the upper part of the thorax.

In raising this muscle, the dissector should look for the *inferior thoracic artery* and *nerve*, Figs. 92, 93, which penetrate its under surface. The nerve is quite small, and comes from the plexus behind the muscles, and passes between the axillary artery and vein. This artery varies very much in its origin, as do all the branches of the axillary artery.

Fig. 91.



A VIEW OF THE DEEPER-SEATED MUSCLES ON THE UPPER FRONT OF THE TRUNK.—1. Cut portion of the sterno-cleido-mastoid. 2. Scalenus medius. 3. Scalenus anticus. 4. Trapezius. 5. Omo-hyoid. 6. Sterno-thyroid. 7. Sterno-hyoid. 8. Subclavius muscle. 9. First external intercostal. 10. Insertion of the pectoralis minor. 11. Cut portion of the coraco-brachialis and short head of the biceps. 12. Body of the pectoralis minor. 13. An external intercostal muscle. 14. Subscapularis. 15. Latissimus dorsi. 16. Serratus magnus.

The SUBCLAVIUS MUSCLE, Fig. 91 (8), *arises* tendinous from the cartilage of the first rib, and is *inserted* into the under

surface of the outer part of the clavicle. It can draw the acromial extremity of the clavicle downwards and forwards, thus assisting other muscles in moving the shoulder in this direction; or when the shoulder is fixed in an opposite direction, it can assist in elevating the ribs. This muscle is placed between two layers of the costo-clavicular aponeurosis. Its relations to the axillary vessels and nerves should be observed.

The AXILLA is now fairly exposed, the whole of its anterior wall being removed. The beginner will be able to dissect and study, *at least*, the principal vessels and nerves, preparatory to a more thorough investigation of its contents, in his future dissections of this region.

Some of the lymphatic glands may be looked for before proceeding to dissect the vessels and nerves. There are several of these glands situated just behind the lower border of the pectoralis major, which are connected with the lymphatics of the mammary gland. Another chain is found at the border of the latissimus dorsi; and others are scattered through the axilla. Not unfrequently these glands are met with in the dissecting-room enlarged from disease.

In dissecting the vessels and nerves of the axilla, much may be done with the handle of the scalpel. They are imbedded in loose areolar tissue, which can be separated from them without much cutting. A good deal of this can be done by introducing the scissors at different points with the blades shut, and then opening them; in this way there is no danger of cutting anything, and when properly done, no occasion for breaking any of the vessels or nerves.

The AXILLARY ARTERY, Fig. 92 (9), extends from the first rib to the lower border of the tendon of the pectoralis major. It is a continuation of the subclavian. Its direction varies with the position of the arm. When the arm is dependent, it forms nearly a right angle with the subclavian; but when the arm is elevated to a right angle with the body, it forms nearly a straight line with that artery. The recollection of this fact may be of some importance in keeping the arm in a proper position, in reducing luxations of the humerus, especially if sufficient time has elapsed for adhesions to be formed.

This artery may be divided into three portions: one above the pectoralis minor, one below it, and another directly behind it. The relations of the *upper* division have already been described. In the *middle* part of its course it is sur-

Fig. 92.

1. The deltoid muscle. 2. The biceps. 3. The tendinous process given off from the tendon of the biceps to the deep fascia of the forearm. It is this process which separates the median basilic vein from the brachial artery. 4. The outer border of the brachialis anticus muscle. 5. The supinator longus. 6. The coraco-brachialis. 7. The middle portion of the triceps muscle. 8. Its inner head. 9. The axillary artery. 10. The brachial artery; a dark line marks the division between these two vessels. 11. The thoracica acromialis artery dividing into its three branches; the number rests upon the coracoid process. 12. The superior and inferior thoracic arteries. 13. The serratus magnus muscle. 14. The subscapular artery. The posterior circumflex and thoracica axillaris branches are seen in the figure between the inferior thoracic and subscapular. The anterior circumflex is observed, between the two heads of the biceps, crossing the neck of the humerus. 15. The superior profunda artery. 16. The inferior profunda. 17. The anastomotica magna inosculating inferiorly with the anterior ulnar recurrent. 18. The termination of the superior profunda, inosculating with the radial recurrent in the interspace between the brachialis anticus and supinator longus.

rounded by the axillary plexus, Fig. 93, and is never ligated at this point unless in cases of amputation.

The *lower* division is the most superficial. It can be reached here very readily from the axillary fossa. At first it usually lies between two roots of the *median nerve*, and then behind and a little to the thoracic side of this nerve. The *external cutaneous nerve* is situated on its outer side, between it and the coraco-brachialis muscle, which it very soon perforates. The *internal cutaneous* is seen on its inner side. This nerve is quite small, and should not be confounded with the

lesser internal cutaneous, which lies close to it on the inner side. The *ulnar* is just behind the internal cutaneous, and to the inside of the artery; this is about the size of one of the roots of the median nerve. Behind the ulnar nerve, and partly behind the artery, is the *musculo-spiral* nerve. This is quite as large as the median nerve. The *circumflex nerve* is directly behind the artery. If the student will make the

Fig. 93.

A View of the Brachial Plexus of Nerves and Branches to the Arm.—1, 1. The scalenus anticus muscle, behind which are the roots of the plexus. 2, 2. The median nerve. 3. The ulnar nerve. 4. The branch to the biceps muscle. 5. The nerve of Wrisberg. 6. The phrenic nerve from the 3d and 4th cervical.

artery his guide, he will have no difficulty in finding and distinguishing these six nerves, or divisions of the axillary plexus. They are described here because the dissection of the artery necessarily involves them, while the dissection of the nerves exposes the artery.

The axillary artery is usually represented as giving off

in all seven branches. These are named the superior and inferior thoracic, the thoracica acromialis, the thoracica axillaris, the subscapular, and the anterior and posterior circumflex. The first named four are very irregular in their origin. The superior thoracic and the thoracica acromialis usually have a common origin just behind the upper border of the pectoralis minor. The distribution of these has already been described. The inferior thoracic and the thoracica axillaris require no special notice. The three remaining branches are more regular in their origin.

The SUBSCAPULAR, Fig. 92 (14), usually arises opposite the lower border of the subscapularis muscle; it may come off higher up, or it may arise in common with some other artery. It runs a short distance on the lower part of the subscapularis, when it gives off a large branch to go to the dorsum of the scapula; this is the *arteria dorsalis scapulæ.* It then continues downwards and backwards on the posterior wall of the axilla to be distributed to the subscapularis, teres major, latissimus dorsi, and serratus magnus.

The ANTERIOR CIRCUMFLEX may consist of one or two small branches, and frequently comes from the posterior circumflex. It passes transversely outwards beneath the coracobrachialis, biceps, and deltoid muscles, and over the anterior part of the surgical neck of the humerus. It is distributed to the muscles above mentioned, and to the shoulder-joint.

The POSTERIOR CIRCUMFLEX is much larger. It passes behind the surgical neck of the humerus, and thus reaches the under surface of the deltoid, to which it is principally distributed. The student will not be able to trace these arteries, for the present, beyond the axilla.

The AXILLARY VEIN, Fig. 94 (2), lies to the thoracic side of the artery in the upper part of the axilla, but gets somewhat in front of it in the lower part. The cephalic vein terminates in it just below the clavicle; the basilic opens into it in the lower part of the axilla; sometimes the axillary vein seems to be a continuation of the basilic. The basilic may join the venæ comites before it reaches the axilla. There are other veins which empty into the axillary; they correspond to the arteries which have been described, and require no particular notice.

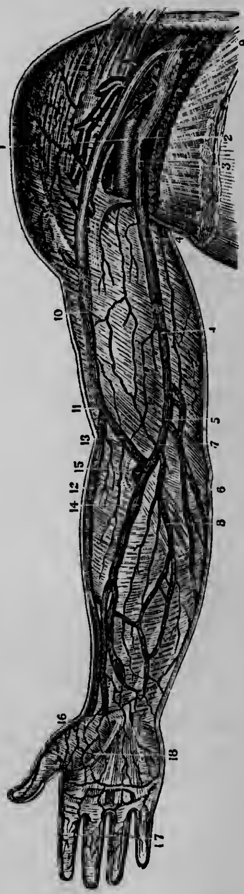
Besides the thoracic nerves and the divisions of the axillary plexus, there are two or three subscapular branches, the long thoracic or external respiratory nerve of Bell, and the nerve of Wrisberg, to be noticed in this dissection, Fig. 93.

The SUBSCAPULAR arise from the outer part of the plexus, and rest on the subscapularis muscle, which, together with the teres major and latissimus dorsi, they supply.

The LONG THORACIC arises from the fifth and sixth cervical, and at first lies behind the axillary plexus, then gets between it and the serratus magnus, on which it rests as it descends, vertically, nearly to its lower border. It sends filaments to this muscle throughout its course. Recollecting its relations to the serratus magnus, the dissector cannot well be at a loss in finding it.

The LESSER INTERNAL CUTANEOUS is a branch of the axillary plexus. It is sometimes called the *nerve of Wrisberg*. At first it is behind the axillary vein, but soon gets to the inner side of it, when it gives off one or more branches to anastomose with the intercosto-humeral. It then passes down the arm on the inner side of the basilic vein, pierces the fascia

Fig. 94.



THE SUPERFICIAL VEINS ON THE FRONT OF THE UPPER EXTREMITY.—1. Axillary artery. 2. Axillary vein. 3. Basilic vein, where it enters the axillary. 4, 4. Portion of the basilic vein which passes under the brachial fascia; a portion of the vein is freed from the fascia. 5. Point where the median basilic joins the basilic vein. 6. Points to the posterior basilic vein. 8. Anterior basilic vein. 9. Point where the cephalic enters the axillary vein. 10. A portion of the same vein as seen under the fascia; the rest is freed from it. 11. Point where the median cephalic enters the cephalic vein. 12. Lower portion of the cephalic vein. 13. Median cephalic vein. 14. Median vein. 15. Vena communicans. 16. Cephalica-pollicis vein. 17. Subcutaneous veins of the fingers. 18. Subcutaneous palmar veins.

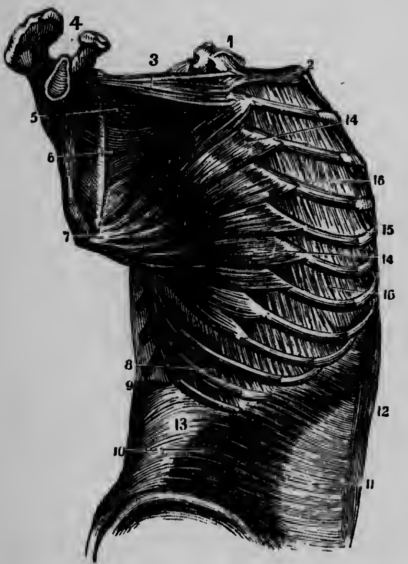
some distance above the elbow, and is distributed to the skin on the inner side of the arm.

The INTERCOSTO-HUMERAL is a branch of the second intercostal nerve; it enters the axilla by perforating the intercostal muscles in the second intercostal space, about midway between the sternum and the vertebral column. It traverses the lower and posterior part of the axilla, and is distributed to the integument of the upper, inner, and posterior part of the arm. It is connected, as before mentioned, to the lesser internal cutaneous nerve, by one or more filaments. Several other *small cutaneous branches* may also be observed when a careful dissection of the axilla is made.

Besides the intercosto-humeral nerve, just described, *several* of the *posterior cutaneous branches* of the intercostal nerves will be met with in this dissection. They are, however, quite small. They perforate the intercostal muscles below the second intercostal space, and are lost in the integument.

The SERRATUS MAGNUS, Fig. 95 (5, 6, 7), is a very broad

Fig. 95.



A LATERAL VIEW OF THE DEEP-SEATED MUSCLES OF THE TRUNK.—1. Vertebra. 2. First rib. 3. Superior origin of the serratus magnus. 4. Acromion scapulæ. 5, 6, 7. Show the convergence of the fibres of the serratus magnus and its insertion into the whole base of the scapula. 8. An external intercostal muscle. 9. Section of the sacro-lumbalis. 10. Transversalis abdominis. 11. Abdominal aponeurosis. 12. Rectus abdominis. 13. Fascia lumborum. 14, 14. Costal origins of the serratus magnus. 15. External intercostal muscle. 16, 16. Two internal intercostal muscles.

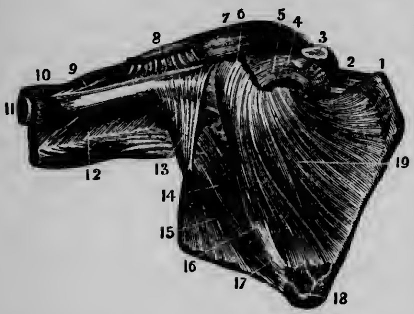
muscle, forming the inner or thoracic wall of the axilla. It *arises* from the superior nine ribs by as many fleshy digitations, the inferior four or five of which project in between the heads of the external oblique, and is *inserted* into the whole length of the base of the scapula. The lower fibres pass upwards and backwards, while the upper fibres have nearly a horizontal direction. This muscle is capable of acting either on the ribs or the scapula. When the ribs are fixed, it draws the scapula forwards. If the lower or upper part act separately, it will rotate the scapula on its axis. If the shoulder be carried backwards and fixed in this position, this muscle, especially the lower part of it, will elevate the ribs, thus co-operating with other muscles in expanding the thorax. That portion of it which arises from the second, third, and fourth ribs, is quite thin. Between it and the ribs and intercostal muscles is an abundance of loose areolar tissue, which allows of a free gliding movement. This muscle should not be divided until the dissector is ready to detach the arm from the trunk. It is not very easy to make a clean dissection of the serratus magnus unless the clavicle is disarticulated from the sternum, and detached from the first rib, so that the scapula can be drawn backwards and separated widely from the thorax.

The SUBSCAPULARIS *arises*, Fig. 96 (19), from the whole of the thoracic surface of the scapula; the fibres converge as they pass upwards and forwards to form a short tendon, which is *inserted* into the lesser tuberosity of the humerus. It passes beneath the coracoid process, and over the neck of the humerus, its tendon being blended more or less intimately with the capsular ligament of the shoulder-joint. Between the tendon and neck of the humerus is a large bursa, which frequently communicates with the joint. Sometimes there are two or three intermuscular septa, which seem to divide the muscle into three or four parts. It assists in keeping the head of the humerus applied to the glenoid cavity; or, it can draw the arm to the thorax, or rotate the humerus inwards. The action of the muscles around the shoulder-joint should be studied, when they have all been dissected, as constituting a group.

The TERES MAJOR *arises*, Fig. 96 (14), from a flat surface near the inferior angle of the scapula; it passes forwards, and

somewhat upwards, and is *inserted*, by a broad thin tendon, into the posterior part of the bicipital groove of the humerus.

Fig. 96.



AN ANTERIOR VIEW OF THE MUSCLES OF THE SHOULDER.—1. Upper part of the body of the scapula. 2. Supra-spinatus muscle. 3. Section of acromion process. 4. Coracoid process. 5. Origin of the second or short head of the biceps. 6. Subscapularis near its insertion. 7. Deltoid. 8. Tendon of the pectoralis major. 9. Insertion of tho doltoid muscle. 10. Brachialis anticus. 11. Cut extremity of the os humeri. 12. Triceps extensor cubiti. 13. Tendon of the latissimus dorsi. 14. Teres major. 15. Axillary portion of the latissimus dorsi. 16. Lower portion of the subscapularis. 17. Origin of the teres major. 18. Lower portion of the scapula. 19. Middle portion of the subscapularis.

Its tendon is closely connected with that of the latissimus dorsi; although a small bursa is commonly found between them and near their insertion. A triangular space will be noticed between this muscle and the lower border of the subscapularis, with its base corresponding to the surgical neck of the humerus.

The *circumflex nerve* and the *posterior circumflex artery* will be seen going backwards through this space close to the humerus, while the *dorsal branch* of the subscapular artery passes through it nearer to the apex.

The LONG HEAD of the TRICEPS EXTENSOR CUBITI, Fig. 96 (12), may be seen at this stage of the dissection, crossing this space vertically behind the teres major.

The LATISSIMUS DORSI, Fig. 96 (13), is necessarily exposed in its upper part in the dissection of the axilla, of which it forms, with the teres major, the lower part of the posterior wall of that space. It lies, at first, in this region, on the outside of the teres major, then below it, and finally anterior to it. It is *inserted* into the posterior part of the bicipital groove by a thin, broad tendon, which usually extends a little higher up than that of the teres major.

The student should now review what he has dissected,

should replace the muscles which have been partially detached, and get a distinct idea of the boundaries of the axilla, and the relations of the vessels and nerves to these boundaries. This is a most important region, and cannot be too carefully studied with reference to abscesses or tumors occurring in the axilla, fractures of the clavicle, luxations of the head of the humerus, ligation of the axillary artery, &c. The coraco-brachialis and the two heads of the biceps flexor have been exposed, to some extent, but the dissection of these muscles had better be postponed till the arm has been detached from the trunk.

Sect. II.—Dissection of the Back.

The subject should now be turned over, so that the back can be dissected preparatory to removing the upper extremity. It will not interfere materially with the dissection of the head and neck, and lower extremities, whenever it is done, as those who are dissecting these parts can attend to the dissection of the back almost as well at one time as another. When several are dissecting on the same subject, some arrangement should be entered into in the dissection of the back, by which some of the class may be at work while the rest are engaged in reading a description of the parts to be examined. In this way, each member of the class may have the full benefit of the dissection.

The subject should be placed on the forepart, with the thorax elevated, by placing blocks beneath it. The muscles are to be made tense by placing the subject in such a position as will effect this object, which can be readily ascertained by the student himself. It may be necessary to place a small block under the pelvis, or to allow the head to hang over the end of the table. The arms and shoulder are to be so placed as to put the muscles attached to the clavicle, scapula, and humerus on the stretch. It is impossible to make a good dissection of the back unless the position of the different parts concerned is properly attended to.

The first incision is to be made through the skin and in the median line from the occiput to the lower part of the sacrum. If it be intended to examine the subcutaneous fascia, it is a matter of little consequence in what direction

the other incisions through the skin are made. To expose the muscles by cutting down on them at once, or by dissecting off the fascia after the skin has been removed, the incisions should be made in the direction of the fibres of the muscles. There is nothing in particular connected with the subcutaneous fascia on the back which requires notice, except the cutaneous nerves and vessels; and even these are not of sufficient practical importance to warrant the student, as a general thing, devoting much time to their dissection.

The NERVES are derived from the posterior divisions of the spinal nerves. The first cervical gives off, ordinarily, no cutaneous branch. The second sends a large branch to the scalp, which accompanies the occipital artery. The third cervical usually sends also a small cutaneous branch to the back of the head. The rest of the cervical nerves ramify in the integument of the back of the neck. The cervical and dorsal perforate the trapezius, while the six lower dorsal perforate the latissimus dorsi and trapezius to reach the skin. Those below the dorsal perforate the latissimus dorsi. They perforate these muscles near the spinous processes, and for the most part are directed outwards. These nerves are easily traced from the intervertebral foramina, especially when a dissection is made for this purpose. They will be met with from time to time in the dissection of the muscles.

The ARTERIES are derived from the occipital, the transverse humeral, the posterior cervical, the intercostal, and the lumbar. It is not necessary to give any description of these arteries in connection with the fascia of the back.

Extending from the occipital protuberance to the spinous processes of all the cervical vertebræ, except the atlas, will be found yellow elastic tissue, named the *ligamentum nuchæ*. This is large in some of the lower animals, but in man it is often quite small and indistinct. Some of the muscles of the neck are attached to this ligament. It assists in supporting the head.

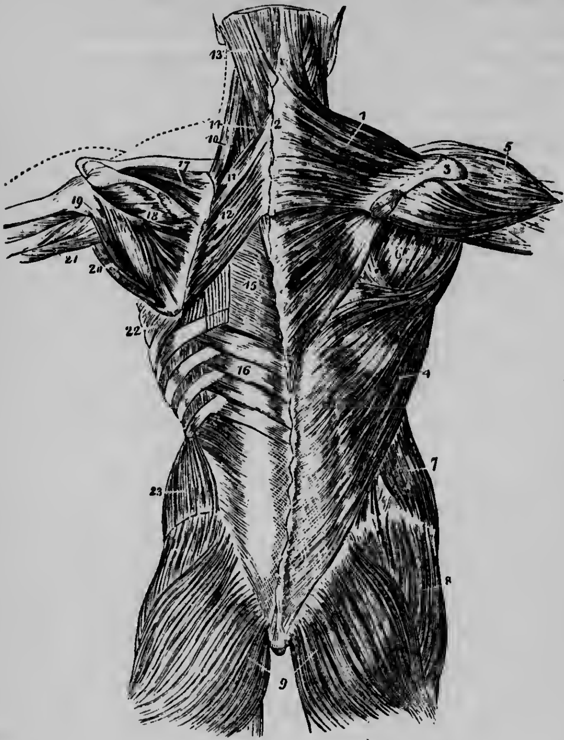
To dissect the TRAPEZIUS, Fig. 97 (1, 2), an incision may be made through the fascia, or through the skin and fascia at the same time, from the first dorsal vertebra, or near it, transversely across to the spine of the scapula. One flap may be dissected upwards and the other downwards until the whole

muscle is exposed. In making this dissection, the student requires no other guide than that afforded by the fibres of the muscle. The direction of these he will see distinctly represented in the drawing of the muscles of the back. In the upper part of the neck, this muscle is frequently very small. It *arises* from the superior ridge on the occipital bone, from the ligamentum nuchæ and the spinous processes of the lower cervical and all the dorsal vertebræ; from this extensive origin the fibres converge and are *inserted* into the posterior third of the clavicle, the acromion process, and the spine of the scapula. The fibres of the lower part pass obliquely upwards, while those of the upper part pass obliquely downwards; the middle fibres have a transverse direction. When the entire muscle acts, it draws the shoulder backwards. When the upper part acts separately, it may draw the shoulder upwards and backwards; when the lower part acts separately, it may draw the shoulder downwards and backwards. If the shoulder be fixed, this muscle may draw the head backwards and to one side; both the trapezii acting at the same time would draw the head directly backwards. That portion of the muscle which arises from the lower cervical and upper dorsal vertebræ is aponeurotic for some distance from its origin. The student should be careful not to remove this tendon with the fascia. The lower part of the muscle, where it passes over the spine of the scapula, is also aponeurotic.

To expose the LATISSIMUS DORSI, Fig. 97 (4), the trapezius must be detached from the lower dorsal vertebræ and turned upwards. The arm should also be drawn upwards to make its fibres tense. It arises from the spinous processes of the six lower dorsal and all the lumbar vertebræ, from the dorsum of the sacrum, the posterior third of the crest of the ilium, and also from the inferior three or four ribs. The fibres pass upwards and forwards, and are *inserted* by a thin tendon into the bicipital groove of the humerus. The lumbar portion of it is, principally, aponeurotic, and forms the posterior layer of the lumbar fascia. The fleshy slips by which it arises from the ribs indigitate with the heads of the posterior part of the external oblique.

The upper part of this muscle is much thinner than the lower; it glides over the inferior angle of the scapula, from

Fig. 97.



The First and Second and part of the Third Layers of Muscles of the Back; the First Layer being shown upon the Right, and the Second on the Left Side.—1. The trapezius muscle. 2. The tendinous portion which, with a corresponding portion in the opposite muscle, forms the tendinous ellipse on the back of the neck. 3. The acromion process and spine of the scapula. 4. The latissimus dorsi muscle. 5. The deltoid. 6. The muscles of the dorsum of the scapula, infra-spinatus, teres minor, and teres major. 7. The external oblique muscle. 8. The gluteus medius. 9. The glutei maximi. 10. The levator anguli scapulæ. 11. The rhomboideus minor. 12. The rhomboideus major. 13. The splenius capitis; the muscle immediately above, and overlaid by the splenius, is the complexus. 14. The splenius colli, only partially seen; the common origin of the splenius is seen attached to the spinous processes below the lower border of the rhomboideus major. 15. The vertebral aponeurosis. 16. The serratus posticus inferior. 17. The supra-spinatus muscle. 18. The infra-spinatus. 19. The teres minor muscle. 20. The teres major. 21. The long head of the triceps, passing between the teres minor and major to the upper arm. 22. The serratus magnus, proceeding forwards from its origin at the base of the scapula. 23. The internal oblique muscle.

which a few additional fibres sometimes arise. There is frequently a bursa between this part of the scapula and the muscle. It will be observed that the lower part of the muscle is inserted higher up than the upper part, resembling in this respect the pectoralis major. The use of this muscle is to depress the arm and shoulder, and draw the arm to the side of the thorax; it may also rotate the humerus inwards. When the arm is elevated and fixed, it raises the lower ribs, thus assisting in respiration.

Between the lower border of the trapezius and the upper margin of the latissimus dorsi, and behind the base of the scapula, is a triangular space, in which the rhomboideus major is seen.

The trapezius is to be raised by detaching it from its origin, and reflecting it forwards. In doing this, the student must be careful that he does not at the same time raise the rhomboidei muscles, which are situated immediately beneath the trapezius.

In raising the latissimus dorsi it is difficult to avoid dissecting up with it the tendon of the serratus posticus inferior. The connection of the tendon of the latissimus with the fascia lumborum at the posterior border of the external oblique should be observed.

In raising the trapezius, the spinal accessory nerve, Fig. 63 (18), may be traced ramifying beneath, and sending branches to it. It gets beneath the muscle a short distance above its clavicular attachment. The *attachment* of the omo-hyoideus to the superior costa of the scapula may be examined at the same time; also the *supra-scapular artery* and *nerve*, as they enter the supra-spinata fossa. These were traced to this point while dissecting the supra-clavicular region in the neck.

The *transverse humeral* and *posterior cervical arteries* will be found beneath the trapezius and above the scapula. The *first* ascends, dividing into branches, which are distributed to the trapezius, levator anguli, scapulæ, and splenius muscles, and anastomosing with the descending branch of the occipital. The *other* one passes backwards to near the posterior superior angle of the scapula, where it gets beneath the levator anguli scapulæ, and descends along the base of the scapula and under the rhomboidei muscles. It supplies the muscles in that region, and anastomoses with the sub-

scapular. The ramifications of this artery cannot be traced until the rhomboidei and levator anguli scapulæ muscles have been dissected.

It will be recollected, in dissecting off the trapezius and latissimus dorsi, that these muscles are perforated by the cutaneous nerves of the back. If the student should wish to trace these nerves to their origin, he must dissect them out of the muscles as they are raised.

The next muscles to be dissected are the rhomboidei major and minor, and the serrati postici superior and inferior.

The RHOMBOIDEUS MAJOR, Fig. 97 (12), *arises* from the spinous processes of the superior four or five dorsal vertebræ; its fibres pass transversely across to the base of the scapula, into which they are *inserted* from the spine to the inferior angle.

The RHOMBOIDEUS MINOR, Fig. 97 (11), *arises* from the spinous processes of the inferior two or three cervical vertebræ, and is *inserted* into that portion of the base of the scapula which corresponds to the spine. The two rhomboidei might be regarded as a single muscle, their separation being often very indistinct. They draw the scapula backwards and somewhat upwards; the lower part acting alone will rotate the scapula, so as to depress the acromion process.

In dissecting off the rhomboidei, a little care is necessary not to raise with them the following muscle, which is partially covered by them.

The SERRATUS POSTICUS SUPERIOR *arises* from the spinous processes of the lower two or three cervical, and about the same number of the superior dorsal vertebræ; it is *inserted* by three fleshy slips into the second, third, and fourth ribs. The action of this muscle is to elevate the ribs into which it is inserted.

The SERRATUS POSTICUS INFERIOR, Fig. 97 (16), *arises* from the spinous processes of the two or three lower dorsal, and upper lumbar vertebræ, and is inserted into the four inferior ribs. Its tendinous origin is closely connected with the latissimus dorsi. Its action is either to depress the lower ribs, and thus assist in expiration, or to fix them, and thus assist the diaphragm, which is an inspiratory muscle.

Extending from one serratus muscle to the other, is a well-marked aponeurosis; it is called the *vertebral aponeurosis*,

Fig. 97 (15). It is continuous below, with the lumbar fascia, through the inferior serratus and tendon of the latissimus dorsi. If pus be formed beneath the posterior layer of the fascia lumborum, there is nothing to prevent it from travelling upwards beneath this aponeurosis.

In dissecting off the serrati and rhomboidei muscles, the student may notice the nerves which perforate them.

The principal muscles of the back yet to be examined, have generally a longitudinal direction, and lie more or less parallel to each other. The student should read carefully a description of them before he attempts their dissection.

The SPLENIUS, Fig. 97 (13), is commonly divided into the *splenius colli*, and *splenius capitis.* This division belongs rather to the upper than to the lower part of the muscle. The *Splenius Colli arises* from the spinous processes of the third, fourth, fifth, and sixth dorsal vertebræ. The *Splenius Capitis arises* from the spinous processes of the inferior cervical, and the first and second dorsal vertebræ. The *former* passes upwards, and is *inserted* by tendinous slips into the transverse processes of the superior two or three cervical vertebræ, while the *latter* also goes upwards, and is *inserted* into the mastoid process of the temporal bone, where it is overlapped by the insertion of the sterno-cleido-mastoideus, and into the occipital bone below the upper transverse ridge.

The actions of these two divisions of the splenius are indicated by their insertions. The splenius capitis draws the head backwards, and to one side. If the corresponding portion of the splenius on the opposite side acts at the same time, they will draw the head directly backwards. The splenius colli acts in the same manner on the neck.

There is a *triangular space* between the splenii muscles of the two sides in the upper part of the neck, which is filled up with dense areolar tissue, and fat. The complexus muscles are seen in this space.

The LEVATOR ANGULI SCAPULÆ, Fig. 97 (10), is situated outside of the splenius. It *arises* by tendinous slips from the transverse processes of the superior three or four cervical vertebræ. Its fibres pass obliquely downwards and backwards, and are *inserted* into the base of the scapula, between the spine and the superior angle. Its origin corresponds nearly with the insertion of the splenius colli. To dissect

it, the scapula should be depressed and carried forwards. The use of this muscle is to elevate the angle of the scapula, and thus depress the acromion process; acting with the trapezius, it assists in raising the shoulder. When the shoulder is fixed, it can bend the head back and to one side.

When this muscle is detached near its insertion, the student will be able to get a view of the *serratus magnus* from behind. By moving the scapula in different directions, the attachments and relations of this large muscle may be distinctly seen.

The relations of the levator anguli scapulæ to the posterior scalenus should, also, be noticed. It is important to keep in view the relations of the parts which are seen in the dissection of the anterior portion of the neck, to those which are observed from behind. It should be borne in mind that the neck presents a *lateral* as well as an *anterior* and *posterior* view.

When the splenius is raised from its origin, and turned upwards, the four following muscles are brought into view in the neck. The splenius is perforated near its spinal attachment, by several nerves which may be noticed in raising it.

The COMPLEXUS, Fig. 98 (8), is a large, powerful muscle, with several tendinous intersections. It lies next to the spine, and *arises* from the transverse processes of the upper three dorsal, and the oblique processes of the four lower cervical vertebræ. Its fibres ascend and are *inserted* into the occipital bone between the two transverse ridges. When one acts alone, it rotates the head, or draws it back and to one side. When both of the complexus muscles act at the same time, they draw the head directly backwards.

The TRACHELO-MASTOIDEUS, Fig. 98 (7), is a small muscle which *arises* from the transverse processes of the upper three or four dorsal, and the inferior three or four cervical vertebræ. Its fibres pass upwards, and are inserted into the back part of the mastoid process. The dorsal portion of this muscle is frequently connected to the cervical by a small fasciculus. It assists other muscles in the movements of the head, as drawing it backwards, or backwards and to one side.

The TRANSVERSALIS COLLI, Fig. 98 (9), is another small muscle, situated on the outside of the preceding. It *arises* by small slips from the transverse processes of the upper

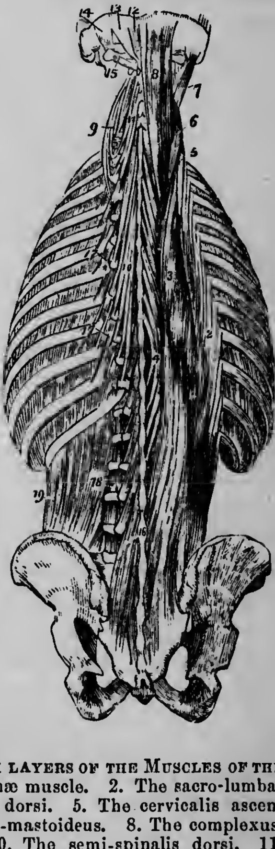
five or six dorsal vertebræ, and passes upwards and outwards, and is *inserted* into the transverse processes of the lower three or four cervical vertebræ. It assists in turning the neck to one side, or in drawing it backwards.

The CERVICALIS ASCENDENS, or DESCENDENS, Fig. 98 (5), is placed on the outside of the transversalis colli. It *arises*, by tendinous bands, from the upper four or five ribs, between their angles and tubercles, and passes upwards and outwards, and is *inserted* into the transverse processes of the fourth, fifth, and sixth cervical vertebræ. The action of this muscle is similar to the last, except that when the neck is fixed, it can assist in elevating the ribs.

It is not always possible to make a clear dissection of the last three muscles, nor is it very important that the student should spend much time in attempting to do it. They seem to be a sort of a continuation upwards of the sacro-lumbalis and longissimus dorsi.

At this stage of the dissection, the student will be able to take a general survey of the posterior spinal nerves in the deeper part of their course, and, also, of the arteries which go to the back. If he has not destroyed the nerves thus far in the dissection, he can now trace first, the CERVICAL.

Fig. 98.



THE FOURTH AND FIFTH, AND PART OF THE SIXTH LAYERS OF THE MUSCLES OF THE BACK.—1. The common origin of the erector spinæ muscle. 2. The sacro-lumbalis. 3. The longissimus dorsi. 4. The spinalis dorsi. 5. The cervicalis ascendens. 6. The transversalis colli. 7. The trachelo-mastoideus. 8. The complexus. 9. The transversalis colli, showing its origin. 10. The semi-spinalis dorsi. 11. The semi-spinalis colli. 12. The rectus posticus minor. 13. The rectus posticus major. 14. The obliquus superior. 15. The obliquus inferior. 16. The multifidus spinæ. 17. The levatores costarum. 18. Intertransversales. 19. The quadratus lumborum.

The OCCIPITALIS MAJOR passes through the complexus, beneath which he will find the *posterior cervical plexus*, which is formed by communicating branches from the upper three cervical nerves. The *first cervical* or *suboccipital*, is quite small; it is situated above the obliquus inferior, and the *second cervical* below it. The *third cervical* is smaller than the *second*, and the *fourth* is smaller than the *third*.

The remaining cervical nerves increase in size from above downwards, and require no particular description. They may be traced to the intervertebral foramina as the deep muscles are dissected.

The POSTERIOR DORSAL NERVES are twelve in number. They divide into *external* and *internal* branches. The external branches are found in the areolar interspace between the longissimus dorsi and the sacro-lumbalis. The upper six are expended upon the muscles, while the lower six are distributed to the muscles and integument. The *external* branches increase, while the *internal* diminish in size, from above downwards. The *lower six* become cutaneous, while the *upper six* are lost in the deep muscles of the spinal fossa.

The POSTERIOR DIVISIONS of the LUMBAR NERVES have the same general arrangement as the lower dorsal.

The POSTERIOR SACRAL NERVES are five in number. The upper three divide into *external* and *internal* branches. The latter are small and muscular; the former are quite large, and become cutaneous, receiving a branch from the last lumbar.

The *posterior cervical* and *transverse humeral arteries* are described in the dissection of the neck.

The OCCIPITAL ARTERY enters the posterior part of the neck beneath the sterno-cleido-mastoideus, passes transversely under the trachelo-mastoideus and splenius, and between the latter and the trapezius becomes subcutaneous, and ascends on the back of the head, Fig. 65 (14). In its course it sends small branches to the muscles with which it is in relation. It sends off quite a large branch, named the *arteria princeps cervicis*, beneath the splenius, which descends on the back of the neck, and anastomoses with branches of the subclavian artery. It also sends a small branch to the dura mater; this passes through the jugular foramen.

The VERTEBRAL ARTERY sends small branches in its course up the neck, to the deep muscles.

The *deep cervical branch* of the subclavian sends branches to the muscles of the back. These anastomose with the occipital and vertebral arteries.

The INTERCOSTAL ARTERIES send branches to that portion of the back which corresponds to the thorax. These branches supply the muscles as they pass through them to reach the skin. They are named the *dorsal branches* of the intercostal arteries.

The LUMBAR ARTERIES send dorsal branches to the muscles and integument in the lumbar region. They correspond to the dorsal branches of the intercostals. The origin and course of these arteries are described elsewhere.

The SACRO-LUMBALIS, the LONGISSIMUS DORSI, and the SPINALIS DORSI, Fig. 98 (1), may now be dissected. They consist of a single mass in the loins, and cannot be distinctly separated in that region. They constitute the *erector spinæ*. They *arise* in common from the dorsum of the sacrum, the sacro-iliac ligaments, from the spinous, transverse, and oblique processes of the lumbar vertebræ, and from the posterior third of the crest of the ilium. They are covered by a thick, strong tendon, from which many of their fibres take their origin. At the upper part of the lumbar region these three muscles can be separated from each other.

The SACRO-LUMBALIS, Fig. 98 (2), is situated on the outer side. It passes upwards, dividing into tendons, which are *attached* to the ribs at their angles. When this muscle is separated from the longissimus dorsi, and raised from the ribs, six or eight muscular and tendinous slips will be observed. These constitute the *accessorius ad sacro-lumbalem*. They *arise* from the lower six or eight ribs, and join the tendons of the sacro-lumbalis. They vary in number and size. The sacro-lumbalis, besides supporting the spine, can depress the ribs, and thus act as a muscle of expiration.

The LONGISSIMUS DORSI, Fig. 98 (3), extends upwards on the inner side of the sacro-lumbalis, and is *inserted* into all the ribs except the upper two or three, between their angles and tubercles, and also into the transverse processes of the

dorsal vertebræ. It acts on the spine, and also on the ribs, as an expiratory muscle.

The SPINALIS DORSI, Fig. 98 (4), lies on the inner side of the last muscle, with which it is usually more or less blended. It *arises* from the spinous processes of the lower two or three dorsal vertebræ, and about the same number of lumbar vertebræ; it is *inserted* into the upper dorsal.

The QUADRATUS LUMBORUM, Fig. 98 (19), should now be dissected, on one side at least, so that the relations of the fascia lumborum may be studied in connection with the muscles of the back. It may also be examined with the muscles in the posterior part of the abdominal cavity. It is situated between the erector spinæ and the cavity of the abdomen. It *arises* from the posterior part of the crest of the ilium and the ilio-lumbar ligament. The fibres pass upwards, and are *inserted* into the transverse processes of the upper four lumbar and the last dorsal vertebræ, and also into the vertebral half of the last rib. An additional set of fibres usually arise from the transverse processes of the lower two or three lumbar vertebræ, pass obliquely upwards, and are inserted into the last rib. The action of this muscle is to depress or fix the last rib, to bend the spine to one side, or to assist in keeping it erect.

The FASCIA LUMBORUM is attached by three laminæ to the vertebral column. The *posterior lamina* is blended with the tendon of the latissimus dorsi and serratus posticus inferior, and is consequently connected to the spinous processes. The *middle layer* is attached to the ends of the transverse processes; while the *anterior layer* is attached to the bases of the transverse processes of the lumbar vertebræ, to the lower rib, and to the ligamentum arcuatum. The internal oblique and transversalis muscles are connected to the vertebral column through the medium of this fascia. The space between the middle and anterior laminæ is wholly occupied by the quadratus lumborum muscle. If pus should form in this space, it might pass upwards or downwards as far as the attachments of this muscle. If pus should collect in the space between the middle and posterior layers, it might travel upwards or downwards along the erector spinæ which occupies this space. The difference between the

location of a lumbar and psoas abscess will be learned in connection with the psoas fascia.

The relations of the colon to the muscles and fascia in the lumbar region should be studied. It will be seen that the colon can be reached in this region by simply dividing the three laminæ of the fascia lumborum along the external borders of the sacro-lumbalis and quadratus lumborum. The relation of the kidney to the muscles in this region, is also deserving of notice with reference to nephritic abscesses.

The following muscles may now be exposed, by removing those last dissected:—

The SEMI-SPINALIS DORSI and COLLI, Fig. 98 (10, 11), might with propriety be considered a single muscle. They present the same arrangement in regard to their origin and insertion, and have a similar function.

The *semi-spinalis colli*, *arises* from the transverse processes of the upper five or six dorsal vertebræ, and passes upwards and is *inserted* into the spinous processes of the second, third, fourth, and fifth cervical vertebræ.

The *semi-spinalis dorsi arises* from the transverse processes of all the dorsal vertebræ below the fifth, excepting the last, and passes upwards and is inserted into the spinous processes of the lower two cervical, and the upper three or four dorsal vertebræ. These muscles co-operate with the erector spinæ.

Situated beneath the two last muscles are a series of small muscles, called, altogether, the MULTIFIDUS SPINÆ. They extend between the spinous and transverse processes. The *upper* one *commences* at the spinous process of the second cervical vertebra, and is *inserted* into the transverse process of the third. The *last one extends* from the spinous process of the last lumbar vertebra to the *sacrum*. The same muscle may extend over one or two intermediate vertebræ. The action of these is nearly the same as the last.

The LEVATORES COSTARUM, Fig. 98 (17), may be examined at the present time, although they are frequently considered as belonging to the external intercostal muscles. They consist of a series of small fan-shaped muscles, which *arise* from the transverse processes, commencing with the last cervical, and extending to the last dorsal. They pass downwards and outwards, and are inserted into the ribs between their angles and tubercles. They increase in length from above down-

wards. Some of the lower muscles pass in part over the first rib below their origin, to be attached to the next one; these have been called the *levatores longiores costarum.*

The INTERSPINALES extend between the spinous processes. Between the dorsal vertebræ they can hardly be said to exist, and are very small in the lumbar region. In the neck, they are found in pairs, corresponding to the bifid condition of the spinous processes. Some of them pass over one or more vertebræ, and are called *supra-spinous.* There is none between the first two vertebræ.

The INTERTRANSVERSALES, Fig. 98 (18), are a series of short muscles, extending between the transverse processes. In the neck, they consist of two fasciculi, an anterior and posterior. In the dorsal region they are generally wanting, excepting between the last two vertebræ. In the lumbar region they are smaller than in the neck. They support the spine, and bend it to one side.

Between the occiput and the upper cervical vertebræ are several small muscles, which are worthy of more attention than some of the preceding.

They are deep-seated, and, to dissect them, the position of the head must be changed, so as to render them tense.

This group of muscles is separated from the complexus by an aponeurosis and dense areolar tissue. They consist of two obliqui and two recti, on each side; between these will be found a triangular space, occupied by fat and areolar tissue, and containing, also, the posterior division of the suboccipital nerve, which is distributed to those muscles, a plexus of veins, and the vertebral artery.

The RECTUS CAPITIS POSTICUS MAJOR, Fig. 98 (13), *arises* from the spinous process of the second vertebra, passes upwards, and is *inserted* into the inferior transverse ridge of the occipital bone. It is of a triangular shape, being broad above and narrow below. It is covered by the complexus, and the superior oblique partly overlaps its insertion.

The RECTUS CAPITIS POSTICUS MINOR, Fig. 98 (12), is a very small muscle, situated beneath the major. It *arises* from the spinous process of the first cervical vertebra, and is *inserted* into the occipital bone, between the inferior transverse ridge and the occipital foramen. The small recti muscles are situated nearer to the median line than the large. The recti

muscles draw the head backwards, or to one side. The large recti may assist in rotating it, or moving it on the axis.

The Obliquus Capitis Inferior, Fig. 98 (15), *arises* from the spinous process of the second vertebra, goes upwards and outwards, and is *inserted* into the transverse process of the atlas. It moves the atlas round the odontoid process, and thus assists in rotating the head.

The Obliquus Capitis Superior, Fig. 98 (14), *arises* from the transverse process of the atlas, and passes upwards and inwards, and is inserted into the occipital bone just above the insertion of the rectus major, which is partly covered by it. The upper part of this muscle is broad and aponeurotic. It bends the head backwards and to one side.

After the muscles on the back of the neck have been dissected, the vertebral artery may be examined in its course through the transverse processes, and as it enters the foramen occipitale. It is accompanied by the vertebral vein.

The great number of muscles on the back, with their numerous attachments, renders this part of the body somewhat difficult of dissection and study. Few students have the time and patience to learn all these muscles and their attachments, and, when it is done, the knowledge thus acquired cannot long be retained. Yet the dissection of the back should not be neglected; it should receive a portion of the time and attention of every student.

Instead of attempting to recollect the exact origin and insertion of each muscle, or any mere arbitrary division based upon their arrangement in layers or strata, he should rather endeavor to fix them in his mind according to their individual or combined action. As, for example, he should arrange and classify in his own mind all those muscles which act directly or indirectly on the shoulder, and through the shoulder on the arm or on the walls of the thorax, as in respiration. In this way he will learn what muscles are at fault in displacements of the scapula, or in curvatures of the spine depending on a loss of antagonism in the muscles of the two sides, or of tone in those of both sides. All the muscles concerned in supporting or moving the head should be grouped together as acting in unison, and also those which act on the vertebral column, but not as acting on separate vertebræ so much as on its different sections. When the muscles of the back are studied

in this way, classified according to their functions, they become an interesting portion of the animal economy. A knowledge of the exact relations of the muscles of the back to each other is not so important as in many other parts of the body, where there are large vessels and nerves, or other important organs, in relation with them.

SECT. III.—DISSECTION OF THE SHOULDER.

In detaching the upper extremity from the trunk, it is desirable to disarticulate the clavicle from the sternum; but it frequently happens that the dissection of the head and neck is not sufficiently advanced to allow of this, at least on both sides, without injuring those parts. In this case, the clavicle should be left attached to the trunk while the scapula is removed with the arm, by separating it at the acromio-clavicular articulation. Even the removal of the scapula will interfere more or less with the lower part of the side of the neck, but not materially, if the back of the neck has been fully dissected. The vessels and nerves in the axilla should be tied together, so that they can be made tense by fastening them to something with hooks or twine.

In dissecting the arm, no specific rules can be laid down in regard to the position. The student must select such position as will put the muscle or muscles which he is dissecting on the stretch, or allow him to trace with the greatest facility the vessels and nerves as he proceeds in his dissection.

The anterior part of the DELTOID was, Fig. 90 (8), exposed with the clavicular portion of the pectoralis major; the remainder of it, Fig. 100 (13), may now be dissected by continuing the dissection from before backwards. The skin may be raised first, so as to examine the deltoid fascia and to trace the *supra-acromial branches*, Fig. 103 (1), from the cervical plexus of nerves, and *cutaneous branches* (2) from the circumflex nerve which is reflected over the posterior margin of the muscle; or the student may remove the skin and fascia from the muscle at the same time. This muscle is composed of very large fasciculi, each one of which seems to be a small muscle of itself.

It *arises*, tendinous and fleshy, from the outer third of the clavicle, from the acromion process and spine of the scapula;

its fibres converge to form a short, thick tendon, which is *inserted* into the deltoid ridge of the humerus. This muscle may be divided into anterior, middle, and posterior portions. It will be seen, from the origin and insertion of the deltoid, that it is of a triangular form, and covers all the outer part of the shoulder-joint. Its action is to raise the arm, and to keep the head of the humerus applied to the glenoid cavity. If the posterior fibres act alone, they will draw the arm upwards and backwards, while the anterior fibres, acting alone, will draw it upwards and forwards. Its origin corresponds to the insertion of the trapezius.

Fig. 99.

A VIEW OF THE DELTOID MUSCLE.—1. Clavicle. 2, 3, 4. Origin of the deltoid from the clavicle, acromion, and spine of the scapula. 5. Body of the scapula. 6. Middle of the deltoid, showing the fasciculated character of its fibres. 7. Its insertion. 8. Shaft of the os humeri.

This muscle should be raised by detaching it from its origin and reflecting it downwards. In dissecting it up from the humerus, the *anterior* and *posterior circumflex arteries* and the *circumflex nerve* will be observed entering its under surface. It will be seen that a blow over the deltoid might, by injuring the circumflex nerve, paralyze this muscle. There is also to be noticed a large *bursa* between it and the upper and outer part of the humerus. Its relations to the shoulder-joint and the parts around it are deserving of special attention. It will be observed that its under surface is more tendinous than the outer, and that many of the muscular fasciculi terminate in a tendinous structure some distance from the point of insertion.

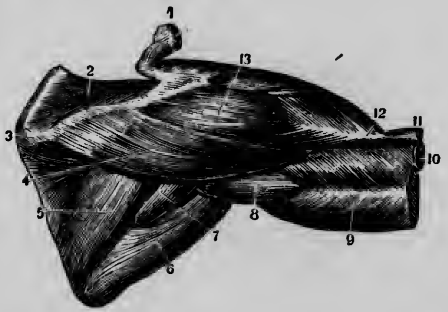
The deltoid muscle is to be preserved, in order to replace it after the parts which are covered by it have been dissected. It is only in this way that its relations can be properly understood.

The SUPRA-SPINATUS, Fig. 100 (2), occupies the supra-spinata fossa. It is covered by the trapezius, and by a thick, dense aponeurosis, named the *supra-spinous fascia*. This fascia is attached to the margins of the fossa, and sends a process for-

wards, to be lost in the tendon of the supra-spinatus muscle. Removing this fascia, the muscle will be exposed. It *arises* from the surface of the whole fossa, except the anterior part, and also from the under surface of the fascia, posteriorly. It passes beneath the acromion process, and ends in a tendon which is *inserted* into the upper part of the great tuberosity of the humerus.

Its tendon is blended with the capsular ligament of the joint, over which it passes. There is a great deal of loose areolar tissue situated around this muscle, where it passes under the acromion process and the coraco-acromial ligament. It assists the deltoid in raising the arm, and, when it is raised, prevents the head of the humerus from being displaced into

Fig. 100.



A POSTERIOR VIEW OF THE MUSCLES OF THE SHOULDER, WITH THE DELTOID.—1. Acromion scapulæ. 2. Supra-spinatus muscle. 3. Spine of the scapula. 4. Posterior portion of the origin of the deltoid. 5. Infra-spinatus muscle. 6. Teres major. 7. Teres minor. 8. Long head of the triceps extensor. 9. Its second head. 10. The shaft of the os humeri. 11. Brachialis anticus. 12. Insertion of the deltoid. 13. Its middle portion forming the round part of the shoulder.

the axilla, by keeping it firmly applied to the glenoid cavity; it also draws the capsular ligament from beneath the acromion process, when the head of the humerus is pressed against it.

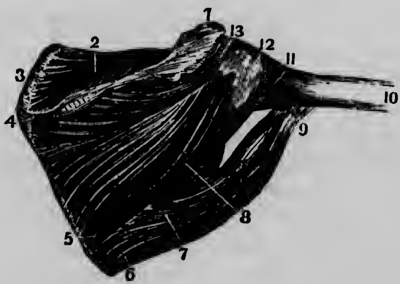
In raising the supra-spinatus, the *supra-scapular artery* and *nerve* are to be traced. They are continued into the infra-spinata fossa by passing under the acromion process, where they will be met with when the infra-spinatus muscle is dissected. The nerve usually passes through the coracoid notch, to enter the supra-spinata fossa, while the artery generally passes over the ligament which subtends this notch and con-

verts it into a foramen. The ligament is named the *coracoid* or *supra-scapular ligament.*

The two following muscles are situated on the dorsum of the scapula, below the spine: the infra-spinatus, and teres minor. Besides the skin and subcutaneous fascia, they are covered with the *infra-spinous fascia*, or *aponeurosis*. This fascia is attached to the margins of the infra-spinata fossa, and, at the posterior border of the deltoid, divides into two layers, one of which is continuous with the deltoid fascia over that muscle, while the other passes beneath it, and becomes continuous with the brachial fascia.

The INFRA-SPINATUS MUSCLE, Fig. 101 (5, 13), *arises* from nearly the whole of the infra-spinata fossa, and posteriorly

Fig. 101.



A POSTERIOR VIEW OF THE MUSCLES OF THE SHOULDER WHICH STRENGTHEN THE ARTICULATION.—1. Acromion scapulæ. 2. Supra-spinatus muscle. 3. Upper angle of the scapula. 4. Spine of the scapula. 5. Origin of the infra-spinatus muscle. 6, 7. Origin of the teres major. 8. Origin of the teres minor. 9. Insertion of the teres major. 10. Shaft of the os humeri. 11. Lower part of the capsular ligament. 12. Insertion of the teres minor. 13. Insertion of the infra-spinatus.

from the infra-spinous fascia. The fibres which arise from the spine of the scapula overlap those below, and they all converge to form a short tendon, which is *inserted* into the great tuberosity of the humerus, just below the insertion of the supra-spinatus, with which it is connected. Its tendon is blended with the capsular ligament. It can assist the deltoid in raising the arm, and drawing it backwards; or it can rotate the humerus outwards; it may also withdraw the capsular ligament from the joint, or, when the arm is raised, depress the head of the humerus.

The TERES MINOR, Fig. 101 (8, 12), is quite a small muscle, and might be regarded as a part of the infra-spinatus. It *arises* from a depression on the dorsum of the scapula, near the inferior border, commencing about an inch from the posterior inferior angle, and from the infra-spinous fascia. It is *inserted* into the great tuberosity of the humerus, just below the insertion of the infra-spinatus. Its action is the same as that of the preceding muscle, with which it is sometimes inseparably connected.

The TERES MAJOR, Fig. 101 (9), was exposed, from before, in the dissection of the axilla; it may now be examined from behind. It *arises* from a rough surface on the dorsum of the scapula, near the inferior angle, and from the fascia covering it. Its direction, insertion, and relations to the latissimus dorsi, have been noticed.

The *long head* of the TRICEPS EXTENSOR CUBITI, Fig. 100 (8), is necessarily brought into view in dissecting the teres major. It may be noticed at the present time as one of the muscles connected to the scapula, and as forming a part of the anatomy of the region now being examined. In raising the infra-spinatus and teres minor, the *supra-scapular artery* and *nerve* are to be traced from beneath the acromion process. The *dorsal branch* of the subscapular artery, by passing over the inferior border of the scapula and beneath the teres minor, also enters this fossa. These arteries anastomose freely with each other, and also with the transverse humeral, along the base of the scapula. *Articular branches* to the shoulder-joint, are derived from both the supra-scapular artery and nerve.

The student should now review the parts which have been dissected about the shoulder. The muscles which have been raised should be replaced and their relations and functions carefully noted without the aid of a book. It will be observed that the deltoid, when placed *in sitû*, covers the following parts: The outer portion of the shoulder-joint, and the upper part of the humerus, ineluding its two tuberosities; the bicipital groove, containing the long head of the biceps, and anterior to this the coraeoid process, and, to some extent, the muscles attached to it; and posteriorly the infra-spinatus, and teres, minor and major, near their insertions.

He is now prepared to understand the position of the head

of the humerus when luxated either backwards, downwards, or forwards, and the new relations it acquires in these displacements to the surrounding parts. He can readily see for himself what muscles will be relaxed, and what will be put on the stretch when the head of the humerus is made, by displacement, to occupy a new position. He can now note the effect of the contraction of the deltoid in producing displacement of the acromion process when broken off, or that of the trapezius in preventing displacement; also the effect of the contraction of the muscles attached to the coracoid process when that is fractured. These practical points should be impressed on the mind while the parts involved are before him.

The shoulder-joint and ligaments around it may now be examined. This can be done without interfering with anything yet to be dissected on the arm.

Fig. 102.

THE LIGAMENTS OF THE SCAPULA AND SHOULDER-JOINT.—1. The superior acromio-clavicular ligament. 2. The coraco-clavicular ligament; this aspect of the ligament is named trapezoid. 3. The coraco-acromial ligament. 4. The coracoid ligament. 5. The capsular ligament. 6. The coraco-humeral ligament. 7. The long tendon of the biceps issuing from the capsular ligament, and entering the bicipital groove.

The clavicle and acromion process are connected by ligamentous fibres which surround the articulation, forming a sort of fibrous capsule. As the fibres are more numerous above and below the joint, they are sometimes spoken of as the SUPERIOR and INFERIOR ACROMIO-CLAVICULAR LIGAMENTS, Fig. 102 (1). This joint sometimes contains two synovial membranes which are separated by an interarticular fibro-cartilage. This fibro-cartilaginous septum, however, is sometimes imperfect, when there will be only one synovial membrane in the joint. The articular surfaces of this joint are very small, rendering it difficult to keep the acromial extremity of the clavicle in its proper place after it has been luxated.

The clavicle is connected to the coracoid process by two ligamentous fasciculi; the posterior and internal is named the CONOID, and the anterior the TRAPEZOID LIGAMENT. They form really but a single ligament, the *coraco-clavicular*, Fig. 102 (2). They extend from the coracoid process to a rough protuberance on the under surface of the clavicle, and about an inch from its acromial extremity. In front they are separated by a space which is filled up with areolar tissue, but posteriorly they appear as a single ligament.

Sometimes quite a perfect joint is found between the coracoid process and the clavicle which allows the latter to move on the former.

The CORACOID LIGAMENT, Fig. 102 (4), subtends the coracoid notch, converting it into a foramen.

The TRIANGULAR, or CORACO-ACROMIAL LIGAMENT, Fig. 103 (3), extends from the coracoid process to the acromion. Its coracoid attachment is much broader than the acromial. It fills up, in part, the notch betwcen these processes and prevents the head of the humerus from being forced upwards between them.

The CORACO-HUMERAL LIGAMENT, Fig. 102 (6), extends from the coracoid process to the great tuberosity of the humerus. It may be considered as a part of the capsular ligament.

The CAPSULAR LIGAMENT, Fig. 102 (5), of the shoulder-joint is attached above to the neck of the scapula, and below to the anatomical neck of the humerus. Its length allows the head of the humerus to be separated a short distance from the scapula. Its strength is greatly increased by its connection with the tendons of the supra-spinatus, infra-spinatus, teres minor, and subscapularis muscles. These tendons, however, do not add to the strength of the lower part of the ligament, and hence there is a predisposition to luxation of the head of the humerus downwards.

When the capsule is partly divided, the tendon of the *long head* of the biceps flexor cubiti, Fig. 102 (7), will be seen passing over the upper part of the articular cavity. It is inside of the ligament, but external to the synovial membrane, which is reflected around it and prolonged an inch or more downwards in the bicipital groove, forming a pouch,

which communicates with the cavity of the joint. The extent of the synovial membrane is worthy of notice, as it is reflected over the head of the humerus, the internal surface of the capsular ligament, including a portion of each of the tendons connected with it, and the glenoid cavity. While it frequently communicates with the bursæ beneath the tendons of the infra-spinatus and subscapularis.

The GLENOID LIGAMENT surrounds the margin of the glenoid cavity, and deepens and increases the extent of its articulating surface. In structure it is fibro-cartilaginous, the cartilage predominating where it is attached to the bone and connected with the articular cartilage. The tendon of the long head of the biceps appears to arise, by two fasciculi, from the upper part of this ligament.

SECT. IV.—DISSECTION OF THE ARM.

Having finished the examination of the shoulder, the next stage in the dissection will embrace the arm and a part of the forearm. An incision may be made through the skin along the forepart of the arm, and in front of the elbow-joint, extending it down four or five inches on the forearm. There is no necessity for making any transverse incision in the skin at present; if it be done, however, care must be taken not to cut the cutaneous vessels and nerves.

After reflecting the skin from the anterior part of the arm and bend of the arm, the following vessels and nerves are to be traced in the superficial fascia, or subcutaneous areolar tissue. As they have been, for the most part, already exposed in the axilla, the student will have no difficulty in following them:—

The CEPHALIC VEIN, Fig. 94 (10), will be found passing down the outer side of the arm. Just above the bend it receives a large branch, the MEDIAN CEPHALIC, Fig. 94 (13), which joins it on its ulnar side. The cephalic now becomes the *radial*, and may be traced as far as the skin has been raised, taking care not to destroy filaments of the external cutaneous nerve, which has now become subcutaneous. The MEDIAN CEPHALIC may also be traced to its commencement in the median vein.

The BASILIC VEIN, Fig. 94 (4), will be found passing down the inner part of the arm. It is much larger than the cephalic; near the bend of the arm it receives the MEDIAN BASILIC, Fig. 96 (5), which joins it from the radial side. The basilic now becomes the ulnar vein, and is to be traced down as far as the cephalic was dissected. The median basilic is to be followed to its termination in the median vein, which may now be exposed for two or three inches.

The MEDIAN VEIN, Fig. 94 (4), will be seen bifurcating to form the median basilic and the median cephalic. The median vein, near its bifurcation, gives off a short trunk, which dips down to join the deep veins; this is named the VENA COMMUNICANS, Fig. 94 (5).

The internal cutaneous, the lesser internal cutaneous, and the intercosto-humeral nerves, should be dissected with the basilic vein. These nerves are easily followed by making them slightly tense, when their course will readily be seen under the fascia.

The INTERNAL CUTANEOUS NERVE, Fig. 103 (6, 7), in the lower part of the arm, divides into an external and internal branch. The *external* division passes over the median basilic vein, and descends on the front of the forearm; while the *internal* passes over the inner part of the elbow, and winds round to the back part of the forearm.

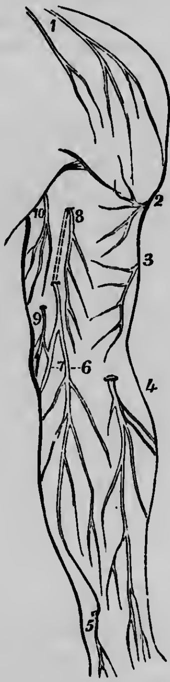
The LESSER INTERNAL CUTANEOUS, Fig. 103 (9), descends on the inner aspect of the arm to the space between the internal condyle and the olecranon process, sending off filaments in its course to the skin on the posterior part of the arm, and for a short distance below the elbow. Near the elbow, it gives off a filament to anastomose with the internal cutaneous. The *intercosto-humeral*, Fig. 103 (10), is lost in the skin on the upper and back part of the arm.

On the outside of the arm are usually two *cutaneous branches*, Fig. 103 (3) and Fig. 104 (5) from the musculo-spiral nerve. One of these generally accompanies the cephalic vein to the bend of the arm; the other descends more externally, and, passing over the elbow-joint, supplies filaments to the skin on the back and upper part of the forearm.

The EXTERNAL or MUSCULO-CUTANEOUS, Fig. 103 (4), becomes superficial just above the bend of the arm, and outside of the tendon of the biceps flexor muscle. A large branch

generally passes behind the median cephalic vein, which may be used as a guide for finding it.

Fig. 103.



Plan of the Cutaneous Nerves on the front of the Arm.—1. Supra-clavicular nerves. 2. Branches of the circumflex nerve. 3. External cutaneous (upper branch) of the musculo-spiral nerve. 4. Musculo-cutaneous. 5. Branch of ulnar nerve. 6. Internal cutaneous: external branch. 7. Inner branch of that nerve. 8. Offset to the upper arm from same. 9. Lesser internal cutaneous. 10. Intercosto-humeral nerve.

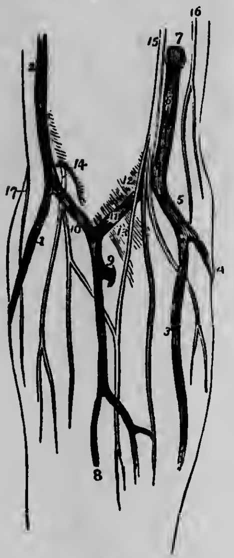
Fig. 104.

Plan of the Cutaneous Nerves of the back of the Arm and Forearm.—1. Supra-acromial branches of the cervical plexus. 2. Cutaneous branches of the circumflex nerve. 3. Internal cutaneous of the musculo-spiral. 4. Intercosto-humeral branches. 5. External cutaneous (inferior) of the musculo-spiral. 6. Ending of the nerve of Wrisberg. 7. Part of the internal cutaneous for the back of the forearm. 8. Offset from the dorsal branch of the ulnar nerve. 9. Radial nerve. 10. Branch of the musculo-cutaneous for the back of the forearm.

The arrangements of the veins in the bend of the arm vary so much, that it is impossible to give a description which

will apply to any considerable number of cases. The two median veins particularly, are very irregular. The cutane-

Fig. 105.



1. The radial vein. 2. The cephalic vein. 3. The anterior ulnar vein. 4. The posterior ulnar vein. 5. The common ulnar vein. 6. The basilic vein. 7. The point at which the basilic vein pierces the fascia. 8. The median vein. 9. The communication between the deep veins of the forearm and the median. 10. The median cephalic vein. 11. The median basilic vein. 12. A slight convexity of the deep fascia, formed by the brachial artery. 13. The slip of fascia derived from the tendon of the biceps, which separates the median basilic vein from the brachial artery. 14. The external cutaneous nerve, piercing the fascia, and dividing into two branches, which pass behind the median cephalic vein. 15. The internal cutaneous nerve, dividing into branches, which pass in front of the median basilic vein. 16. The nerve of Wrisberg. 17. The spiral cutaneous nerve, branch of the musculo-spiral nerve.

ous nerves, on the contrary, usually have nearly the same position; so that they may be avoided by selecting a proper place for opening a vein. The place selected is more important to be considered in bleeding than any particular vein.

As the internal cutaneous nerve is more superficial, usually passing in front, Fig. 105 (12), of the median basilic, than the external cutaneous, which is commonly situated behind the median cephalic, Fig. 105 (14), the outer part of the bend of the arm should be selected for opening a vein. The lymphatics, also, are less numerous here than in the middle or inner part of this region, and are not so liable to be wounded. The relations of the veins in the bend of the arm to the median nerve and brachial artery, will be observed at another time.

The Vena Communicans, Fig. 99 (15) and Fig. 105 (9), may now be examined; so that the superficial fascia can be divided and reflected laterally from the median line in the same manner as the skin. This is a short vein, which

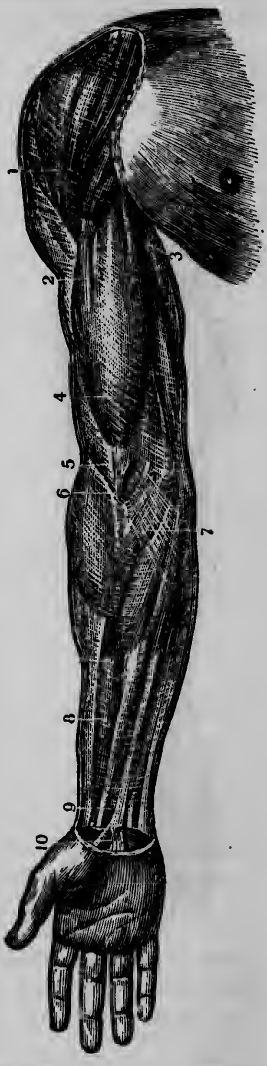
establishes a direct communication between the superficial and deep-seated veins. It has no valves; and hence, in varicose aneurism, or aneurismal varix, it allows the blood to pass readily from one set of veins to the other.

The SUPERFICIAL LYMPHATICS accompany the veins, especially the basilic. A single lymphatic gland is placed in front of the inner condyle. The lymphatics terminate in the axillary glands.

The DEEP FASCIA, or BRACHIAL APONEUROSIS, Fig. 106, lies directly beneath the superficial fascia. It consists of fibres, running, some in a longitudinal, some in a spiral, and others in a circular direction. It increases in thickness and strength from above downwards. Above, it is connected to the pectoral, deltoid, infra-spinous, and axillary fasciæ, also to the tendons of several of the muscles about the shoulder; some of which are capable of rendering it more or less tense when they contract. It is connected to the humerus by two processes, or septa, an external and an internal.

The *external* is attached to the outer part of the humerus, extending from the outside of the deltoid ridge to the external condyle, separating the triceps extensor from the brachialis anticus muscle, and, at the same time, giving origin to many fibres of these muscles, especially at the

Fig. 106.



A VIEW OF THE FASCIA BRACHIALIS IN ITS WHOLE EXTENT.—1. Portion covering the deltoid muscle. 2. Portion covering the upper part of the biceps. 3. Portion covering the coraco-brachialis. 4. Portion covering the lower part of the biceps. 5. Tendon of the biceps. 6. Opening for the vein. 7. Aponeurosis as strengthened by the expansion from the tendon of the biceps. 8. Fascia over the flexor sublimis. 9. Fascia over the flexor carpi radialis. 10. Commencement of the palmar fascia.

lower part of the arm. The musculo-spiral nerve and superior profunda artery perforate this intermuscular septum.

The *internal septum* commences at the insertion of the teres major and latissimus dorsi, and extends to the inner condyle of the humerus. It is narrower above than below. The brachialis anticus and triceps extensor cubiti muscles are intimately connected with it in the lower part of the arm. It is perforated by the ulnar nerve.

Fig. 107.

The brachial aponeurosis furnishes sheaths for the muscles of the arm, and is connected to the sheaths of the brachial vessels and nerves. Besides its attachment to prominent points about the elbow, it is continued into the aponeurosis of the forearm. It binds down the muscles of the arm, gives attachment to muscular fibres, and serves to protect the brachial vessels and nerves.

The Biceps Flexor Cubiti Muscle, Fig. 107 (15), may now be exposed by dividing the aponeurosis along the middle of the forepart of the arm, and reflecting it to each side. The heads of this muscle *arise*, as has been seen, the long one from the upper part of the glenoid cavity, and the short from the coracoid process, in common with the coraco-brachialis, from which it cannot be separated without making an arbitrary division. The heads unite just above the middle of the humerus, to form quite a large, prominent belly, which ends in a flat tendon, a short dis-

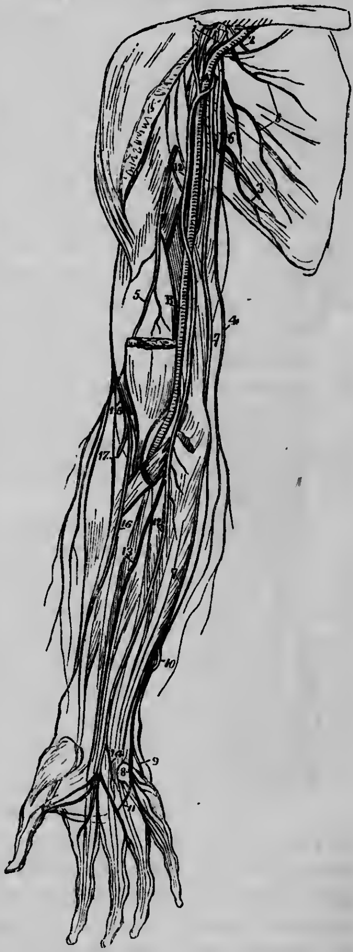
A View of the Muscles on the Front of the Arm.—1. Clavicle. 2. Coracoid process and origin of the short head of the biceps. 3. Acromion scapulæ. 4. Head of the os humeri. 5. Tendon of the biceps muscle in the bicipital groove. 6. Coraco-humeral dissected off. 7. Cut portion of the pectoralis major. 8. Long head of the biceps. 9. Insertion of the deltoid. 10. Cut portion of the tendinous insertion of the pectoralis minor. 11. Coraco-brachialis. 12. Short head of the biceps. 13. Latissimus dorsi. 14. Inner portion of the triceps. 15. Body of the biceps. 16. Outer portion of the triceps. 17. Brachialis anticus. 18. Origin of the flexor muscles. 19. Brachialis anticus near its insertion. 20. Tendon of the biceps. 21. Fasciculus from the biceps tendon to the brachial aponeurosis. 22. Flexor carpi radialis. 23. Palmaris longus. 24. Supinator radii longus.

tance above the elbow-joint. The short head is muscular from near its origin; while the long one continues tendinous to near their junction. The latter is bound down in the bicipital groove by transverse fibres, which are said to be torn sometimes, allowing a displacement of this tendon. The biceps is *inserted* into the tubercle of the radius.

From its tendon proceeds an aponeurotic expansion, Fig. 107 (21), which passes inwards and downwards across the elbow-joint, and joins the aponeurosis of the forearm, which, by means of this connection, is made tense by the contraction of the biceps muscle. This fibrous expansion is liable to be wounded in bleeding at the bend of the arm, which may be followed by lameness in the limb for a few days.

This muscle flexes the forearm on the arm, and renders its aponeurosis tense. It can also rotate the radius outwards, and assist in abducting the arm, as it is attached above the shoulder-joint. The action of the biceps on the upper part of the radius, when a fracture occurs just below the tubercle, is to rotate the upper fragment outwards, and draw it upwards,

Fig. 108.



A Plan of the Nerves of the Arm.—A. Axillary artery. B. Brachial artery. Nerves: 2. Supra-scapular. 3. Subscapular. 4. Internal cutaneous. 5. Musculo-cutaneous. 6. Circumflex. 7. Ulnar. 8. Superficial branch of the same to the hand. 12. Median. 13. Anterior interosseous. 15. Musculo-spiral. 16. Radial. 17. Posterior interosseous.

as in flexion of the forearm. The dissection of the deep part of the tendon of the biceps may be postponed until the vessels in this region have been examined.

The CORACO-BRACHIALIS, Fig. 107 (11), may next be dissected. It *arises* from the coracoid process, and extends obliquely downwards to the middle third of the humerus into the inner part of which it is *inserted*, between the brachialis anticus and deltoid in front, and the triceps extensor behind. In dissecting this muscle, the student must be careful not to cut the external cutaneous nerve, which commonly passes obliquely through it from above downwards and outwards. The coraco-brachialis elevates and draws the arm forwards, and in front of the thorax; it can also rotate it outwards. When the arm and forearm are fixed, both this and the biceps can act on the scapula.

The *arteries* which supply the biceps and coraco-brachialis muscles, are branches from the axillary and brachial; they do not require any particular description.

The *nerves* are derived principally from the external cutaneous. Before raising the biceps and coraco-brachialis, it will be proper to proceed with the dissection of the brachial vessels and nerves.

The *brachial artery*, *venæ comites*, and *median nerve*, should be dissected down the arm together. The nerve will be found at first, lying in front and a little to the outside of the artery, near to the coraco-brachialis muscle, but gradually, as it descends, getting to the inside of it. The external cutaneous nerve sometimes comes from the median, instead of the brachial plexus, and, not unfrequently, a branch is given off from the median, which joins the external cutaneous beneath the biceps. The median nerve is sometimes found behind the brachial artery.

The BRACHIAL ARTERY, Fig. 92 (10), is a continuation of the axillary. It extends from the lower borders of the tendons inserted into the bicipital groove to the bend of the arm, where it divides into the radial and ulnar. It is not covered by any muscle throughout its whole course, unless it is overlapped by the belly of the biceps, when that muscle is unusually developed. It is in relation on the outside with the coraco-brachialis above, and the biceps lower down. Behind, it is in relation above with the tendons of the teres

major and latissimus dorsi, the triceps extensor, and the coraco-brachialis; below these it rests on the brachialis anticus. In the upper part of the arm it is placed on the inner side of the humerus, but is in front of the bone, where it rests on the brachialis anticus.

At the bend of the arm it is situated beneath the aponeurotic expansion from the tendon of the biceps muscle, which protects it to some extent when the median basilic vein is opened in bleeding. To ascertain the exact position of it, before opening the vein the biceps should be relaxed, otherwise the tension of this aponeurosis might prevent the pulsation of the artery being felt. The median nerve here lies on the inner side of the artery.

Usually there is no necessity for opening a vein over either the artery or nerve, and hence the liability of wounding either of them may be avoided. The anomalies which occur in the brachial artery are interesting in a surgical point of view; but they vary so much, that a description of them must be omitted. It may be mentioned, however, that the one most commonly met with is a high division of the artery into the radial and ulnar, which may occur at any point in the arm, even as high as the axilla. It gives off the four following branches:—

The *superior profunda*, Fig. 92 (15), arises just below the tendon of the teres major, and passes obliquely downwards and backwards to enter the fissure between the two heads of the triceps which arise from the humerus; it accompanies the musculo-spiral nerve. Sometimes this branch arises in common with the posterior circumflex, or with the inferior profunda.

The *inferior profunda*, Fig. 92 (16), arises lower down, and proceeds obliquely downwards to the inner part of the elbow-joint, accompanying in the latter part of its course the ulnar nerve.

The *nutritious branch* is given off near the middle of the humerus, which it penetrates through the nutritious foramen.

The *anastomotic branch*, Fig. 92 (17), arises usually about two inches above the bifurcation into the radial and ulnar, and goes to the inner part of the elbow. These branches, except the nutritious, will be noticed again in connection with the vascular anastomosis around the elbow-joint.

The VENÆ COMITES consist of two veins, one on each side of the artery; they communicate frequently with each other across it. Sometimes there is found a collateral vein opening into the venæ comites, both in the upper and lower part of the arm. These veins are to be cut away in dissecting the artery.

The ULNAR NERVE, Fig. 93 (3), passes down, at first, close to the inner side of the artery, but gradually diverges from it as it proceeds towards the notch between the inner condyle and the olecranon process, through which it goes to the forearm. It gives off no branches in the arm. It is accompanied in the lower part of its course, as before mentioned, by the inferior profunda artery.

The MUSCULO-SPIRAL NERVE, Fig. 108 (15), cannot be traced at this stage of the dissection further than the fissure which it enters with the superior profunda artery in the triceps extensor muscle. Before it enters the fissure it usually gives off two or three small branches, which go to the muscles and the skin on the inner part of the arm.

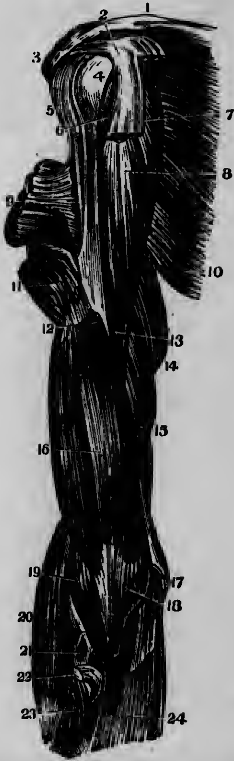
The belly of the biceps muscle may now be divided near the junction of its two heads, and turned upwards and downwards, to expose the external cutaneous nerve and the brachialis anticus muscle. The *nerve*, Fig. 108 (5), will be found passing obliquely downwards and outwards between the biceps, and the brachialis anticus to become subcutaneous at the outer part of the bend of the arm. It supplies branches in its course to the coraco-brachialis, the biceps, and the brachialis anticus. Its cutaneous branches may now be traced for a short distance down on the forearm.

The BRACHIALIS ANTICUS, or INTERNUS, Fig. 109 (16), *arises* from the whole of the anterior surface of the humerus, from the deltoid ridge to near the elbow-joint. It extends on both sides beyond the biceps, but more on the inner than on the outer side. It extends a little upwards in its origin on each side of the insertion of the deltoid. Its fibres converge to form a short tendon, which is *inserted* into the anterior and lower part of the coronoid process of the ulna. The tendon of the biceps lies partly upon it and to its outside. This muscle assists the biceps in flexing the forearm on the arm; it also withdraws the synovial membrane from the angle of

the joint. In case of fracture of the coronoid process, it may draw the fragment upwards.

When the tendons of this muscle and the biceps are dissected, and reflected downwards, the anterior part of the elbow-joint is exposed, being covered only by a few ligamentous fibres. On the outside of the brachialis anticus, and applied closely to it, is the supinator longus muscle. When these muscles are separated, the musculo-spiral nerve and the superior profunda artery will be found deeply embedded betwcen them.

Fig. 109.



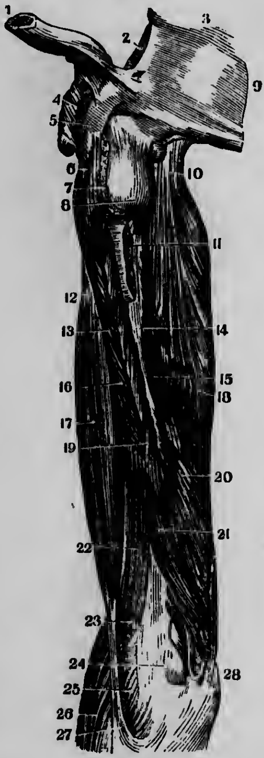
An Anterior View of the Deep-seated Muscles of the Arm.—1. Clavicle. 2. Coracoid process of the scapula. 3. Acromion scapulæ. 4. Head of the os humeri. 5. Tendon of the long head of the biceps. 6. Upper portion of the coraco-brachialis. 7. Origin of the short head of the biceps. 8. Body of the coraco-brachialis. 9. Insertion of the pectoralis major. 10. Latissimus dorsi. 11. Insertion of the deltoid. 12. Origin of the brachialis internus. 13. Insertion of the coraco-brachialis. 14. Middle portion of the triceps. 15. Its lower anterior portion. 16. Body of the brachialis anticus. 17. Internal condyle. 18, 19. Insertion of the brachialis anticus. 20. Supinator radii longus. 21. Opening made in the capsular ligament. 22. Cut tendon of the biceps at its insertion. 23. Supinator radii brevis. 24. Aponeurosis.

The arm may now be turned over for the purpose of dissecting the back of it. The skin and superficial fascia may be removed by dissecting from either the inner or outer side. After examining the brachial aponeurosis, it is to be removed by dissecting in the direction of the fibres of the triceps extensor muscle, having made that muscle tense by flexing the forearm on the arm and fixing the scapula.

The Triceps Extensor, Fig. 110 (10, 14, 19), *arises* by three heads, one from the scapula, and two from the humerus. The *first*, or longest head, *arises* from the inferior costa of the scapula, occu-

pying about an inch, commencing at the lower part of the glenoid cavity, where it is slightly connected to the capsular ligament. The *second* head arises from the posterior part of the humerus, commencing just below the great tuberosity, and extending down to the external condyle, from which it also arises in connection with the anconeus; some of its fibres arise from the external intermuscular septum. The *third* and shortest head *arises* from the inner and back part of the humerus, commencing just below and behind the insertion of the teres major, and extending down to the internal condyle; some of its fibres come from the internal intermuscular septum. This head is sometimes called the *brachialis externus.* These three heads unite above the middle of the arm, and form a large muscular belly, which ends in a broad flat tendon, which is *inserted* into the olecranon process, and connected with the aponeurosis of the forearm. This muscle, it will be seen, occupies in its origin nearly the whole of the posterior surface of the humerus. It ex-

Fig. 110.



A Lateral View of the Deep-seated Muscles on the Back of the Arm.—1. Section of the clavicle. 2. Fossa supra-spinata of the scapula. 3. Base of the scapula. 4. Coraco-acromial ligament. 5. Coracoid process. 6. Origin of the coraco-brachialis. 7. Section of the subscapularis muscle. 8. Head of the os humeri. 9. Section of the body of the scapula. 10. Origin of the long head of the triceps. 11. Insertion of the latissimus dorsi. 12. Edge of the biceps flexor cubiti. 13. Coraco-brachialis. 14, 15. Origin of the second head of the triceps. 16. Lower portion of the coraco-brachialis. 17. Body of the biceps. 18. Body of the triceps. 19. Origin of the third head of the triceps. 20, 21. Its middle portion, known as the brachialis externus. 22. Brachialis anticus. 23. Its insertion. 24. Posterior ligament of the elbow. 25, 26. Origin of the flexors of the forearm. 27. Prolongation of the tendon of the biceps to the fascia brachialis. 28. Olecranon.

tends the forearm on the arm, and draws the synovial membrane from the joint when the forearm is extended. By its long head it can act on the scapula. When the olecranon process is broken off, it may draw it upwards.

The musculo-spiral nerve and superior profunda artery may now be traced in the spiral groove through the triceps muscle. To do this the muscle must be divided along the course of the artery and nerve, when the branches given off by them to the muscle, while passing through it, may be observed.

The *artery*, on reaching the outer and lower part of the arm, divides into several branches, which are distributed about the elbow-joint, some of them anastomosing with the anastomotic and recurrent branches of the radial and posterior interosseous arteries.

The *nerve*, when it leaves the triceps, gets between the brachialis anticus and supinator longus muscles, between which it goes to the bend of the arm, where it divides into the radial and posterior interosseous. These divisions will be traced in the dissection of the forearm. The *internal* and *external cutaneous branches* of this nerve have been noticed. Besides supplying muscular branches to the triceps extensor, it sends filaments to the brachialis anticus, supinator longus, and extensor carpi radialis longior.

In dissecting the forearm, it will be sufficient to remove, in the first place, the skin in front down to the wrist. To do this, the incision which was made to dissect the arm may be continued down the middle of the forearm to the wrist, where a transverse incision is to be made. The vessels and nerves contained in the superficial fascia of the forearm, both in front and on the back, are the same as have been seen in the previous dissection. If they have been preserved, the student will have no difficulty in tracing them.

The veins vary so much in their arrangement on the forearm that it is hardly necessary to give any particular description of them. If they have been injected, they are distinctly seen and easily followed. In the living person, especially if not fat, they are made prominent under the skin by compressing the veins of the arm. They anastomose freely with each other, forming a complete network. They are divided into the *radial*, *median*, and *ulnar*. If the student should wish to trace them and the cutaneous nerves, he must dissect

the skin from the whole of the forearm and the back of the hand at the same time. If this be done, the parts must be kept covered with the integument or with wet cloths during the intervals between the times allotted to dissecting.

The INTERNAL CUTANEOUS NERVE, Fig. 103 (6, 7), will be found to continue down the forearm to the wrist; the anterior branch, which was seen in connection with the median basilic vein, on the front part, and the posterior branch on the back part of the arm. These branches are situated on the ulnar side. The anterior frequently anastomoses near the wrist with a branch from the ulnar.

The EXTERNAL CUTANEOUS NERVE, Fig. 104 (4), is situated on the radial side. Near the lower third of the forearm it divides into two branches; one continues down to the integument, covering the ball of the thumb, and usually sends a filament through the deep fascia to ramify on the radial artery; it anastomoses with the radial nerve; the other branch is reflected round to the back of the forearm, where it also anastomoses with the radial.

The *lower external cutaneous branch* of the musculo-spiral nerve will be found passing down on the back of the forearm to near the wrist. *Branches* of the radial and ulnar nerves are distributed on the back of the hand and fingers; but these will be traced more readily from the main trunks.

Beneath the superficial fascia is a thick, dense *aponeurosis*, Fig. 106, which invests the muscles of the forearm generally, and furnishes fibrous sheaths for them separately. In structure, it is similar to the brachial aponeurosis. It is thicker behind than in front, and in the upper than in the lower part of the arm. It gives origin to muscular fibres both from its under surface and from the processes which it sends in between the muscles, especially near the elbow. Its connections with the brachial aponeurosis and with the fibrous expansions from the tendons of the biceps and triceps, have been seen.

It is firmly attached to the olecranon process and to the inner part of the ulna down to the styloid process. Below, it is connected to the anterior and posterior annular ligaments. Between its attachments to the upper part of the ulna there is a subcutaneous surface on that bone. Just below the bend of the arm it stretches across a sulcus that is

formed by the anterior and posterior muscles of the forearm. There is a deficiency in it in front of the elbow-joint which allows the superficial fascia to join the deep areolar tissue, and also the vena communicans to reach the deep-seated veins, Fig. 106 (6).

When this aponeurosis is removed from the front of the forearm as far as it can be done without interfering with the muscles which partly arise from it, a *sulcus* will be observed extending from the bend of the arm to the wrist, and separating the muscles on the back from those on the front of the forearm. The upper part of this sulcus or depression is quite broad and deep. In it are found the median nerve and the bifurcation of the brachial artery, and the venæ comites. The radial artery and its corresponding veins, occupy this sulcus nearly its whole length; the middle third contains also the radial nerve. On the inner side of the lower two-thirds of the forearm is another *sulcus*, which contains the ulnar artery, its venæ comites, and the ulnar nerve.

There are eight muscles on the anterior part of the forearm. Two of these are inserted into the radius; they are the *pronators*. Two of them pass over the wrist-joint to be inserted into two of the metacarpal bones; these are *carpal flexors*. Three of them go to the thumb and fingers; these are *digital flexors*; the one going to the thumb is called the *flexor longus pollicis*. The eighth one, the *palmaris longus*, is connected to the annular ligament and palmar aponeurosis.

The student should familiarize himself with these muscles by making the several movements with his own hand as they respectively depend upon them. Three simple movements, such as flexing the fingers and thumb, then the hand on the forearm, and lastly, turning the hand on the palm, call into action seven of these muscles. A familiarity with their actions will assist him greatly in recollecting their names and their relative position. In dissecting them, it is better to commence on the radial side. The two most prominent ones on this side are the pronator radii teres and flexor carpi radialis. They form the inner boundary of the sulcus in which lies the radial artery.

The Pronator Radii Teres, Fig. 111 (4), *arises* from the internal condyle and aponeurosis of the forearm, and also by

a small head, from the coronoid process of the ulna. The median nerve passes between these two origins. Its fibres pass obliquely downwards and outwards, to be *inserted* into the outer part of the middle third of the radius. The upper part of this muscle is superficial and prominent, while the lower part is deep-seated, having the radial artery and nerve in front of it. It rotates the radius inwards, and pronates the hand; it may also assist in flexing the forearm.

Fig. 111.

Superficial Layer of the Muscles of the Forearm.—1. The lower part of the biceps, with its tendon. 2. A part of the brachialis anticus, seen beneath the biceps. 3. A part of the triceps. 4. The pronator radii teres. 5. The flexor carpi radialis. 6. The palmaris longus. 7. One of the fasciculi of the flexor sublimis digitorum: the rest of the muscle is seen beneath the tendons of the palmaris longus and flexor carpi radialis. 8. The flexor carpi ulnaris. 9. The palmar fascia. 10. The palmaris brevis muscle. 11. The abductor pollicis muscle. 12. One portion of the flexor brevis pollicis; the leading line crosses a part of the abductor pollicis. 13. The supinator longus muscle. 14. The extensor ossis metacarpi, and extensor primi internodii pollicis, curving around the lower border of the forearm.

The Flexor Carpi Radialis, Fig. 111 (5), *arises* from the internal condyle and fascia, including the intermuscular septum, in common with the preceding muscle. It forms a thick belly which becomes tendinous near the middle of the forearm, and continues so to its *insertion* into the base of the metacarpal bone of the index finger. The dissection of this muscle beneath and below the annular ligament with the lower part of the others which go to the hand, must be postponed until the palm of the hand is dissected. It flexes the hand on the forearm, and may assist in pronation and abduction of the same.

The Palmaris Longus, Fig. 111 (6), is the next muscle to be dissected. Its *origin* is similar to that of the flexor carpi radialis. It forms a short belly, which ends in a long, slim tendon; this extends down the forearm to the annular ligament and palmar aponeurosis, into which it is *inserted*. It is sometimes

absent. It flexes the hand, and makes tense the palmar aponeurosis. It is separated from the muscle beneath it by a thick fascia.

The Flexor Carpi Ulnaris, Fig. 111 (8), is placed on the ulnar side of the palmaris longus. It *arises* from the internal condyle, and from the ulna nearly its whole length, and from the fascia of the forearm. The ulnar nerve passes between its origins from the condyle and the olecranon process. Its origin from the lower part of the ulna is aponeurotic. It is *inserted* into the pisiform bone, and through it into the metacarpal bone of the little finger; it is, also, connected by some fibres with the muscles of the little finger. Its tendon is much shorter than that of the flexor carpi radialis. It flexes the hand, and assists in adduction. The ulnar artery and nerve are situated along the outer border of its inferior two-thirds.

The flexor carpi radialis and palmaris longus may now be divided about three or four inches below their origin, and turned upwards, detaching the fibres from the intermuscular septa. The following muscle will then be exposed.

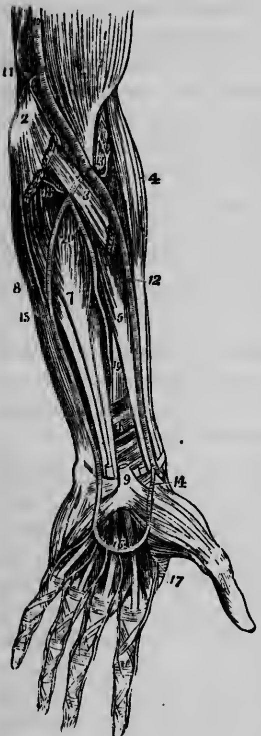
The Flexor Sublimis or Perforatus Digitorum Communis, Fig. 111 (7), *arises* from the internal condyle, internal lateral ligament, and from both bones of the forearm; from the coronoid process of the ulna, and from the radius below its tubercle; it also obtains some fibres from intermuscular septa. It forms a large muscular belly, which terminates in four tendons a little below the middle of the forearm; these tendons pass under the annular ligament, the two on the radial side being situated somewhat anterior to the others, and through the palm of the hand, to be *inserted* into the second row of phalangeal bones. It flexes the fingers, and assists in flexing the hand and forearm.

Before proceeding further with the dissection of the muscles, the arteries and nerves of this region should be examined. Some of them have already been seen, but not dissected and studied.

There are three arteries in the forearm which extend from the bend of the arm to the wrist. They are the radial, the ulnar, and the anterior interosseous. From these three arteries recurrent branches are given off, to anastomose around the elbow-joint, with the anastomotic and two profound branches of the brachial artery.

The RADIAL ARTERY, Fig. 112 (12), although usually not so arge as the ulnar, appears to be a continuation of the brachial. It is covered in front merely by the integument and aponeurosis; hence it is superficial in its whole course. It has one muscle in relation with it on the outside, the supinator longus; two on the inner side, the pronator radii teres, and flexor carpi radialis; and five behind it, and on which it lies. These are arranged in the following order, commencing above: the supinator brevis, pronator radii teres, flexor sublimis digitorum, flexor longus pollicis, and the pronator quadratus; below this last muscle the artery rests on the radius.

Fig. 112.



Near its commencement it gives off quite a large branch, the *radial recurrent*, Fig. 112 (13). This is distributed to the muscles on the outside of the elbow, and anastomoses with the superior profunda. In its course down the arm it gives off numerous branches, which are not named. In the lower part of the arm it sends off the *superficial volar branch*, Fig. 112 (14), which either passes over the mass of muscle that forms the thenar of the

THE ARTERIES OF THE FOREARM.—1. The lower part of the biceps muscle. 2. The inner condyle of the humerus, with the humeral origin of the pronator radii teres and flexor carpi radialis divided across. 3. The deep portion of the pronator radii teres. 4. The supinator longus muscle. 5. The flexor longus pollicis. 6. The pronator quadratus. 7. The flexor profundus digitorum. 8. The flexor carpi ulnaris. 9. The annular ligament, with the tendons passing beneath it into the palm of the hand; the figure is placed on the tendon of the palmaris longus muscle, divided close to its insertion. 10. The brachial artery. 11. The anastomotica inosculating superiorly with the inferior profunda, and inferiorly with the anterior ulnar recurrent. 12. The radial artery. 13. The radial recurrent artery inosculating with the termination of the superior profunda. 14. The superficialis volæ. 15. The ulnar artery. 16. Its superficial palmar arch giving off digital branches to three fingers and a half. 17. The magna pollicis, and radial artery. 18. The posterior ulnar recurrent. 19. The anterior interosseous artery. 20. The posterior interosseous, as it is passing through the interosseous membrane.

thumb to unite with the superficial palmar arch, or it may end in branches to these muscles. Sometimes this branch is very large, and forms a considerable portion of the palmar arch, or it may divide into digital branches. In this dissection the radial artery disappears under the tendons of the extensor muscles of the thumb.

Sometimes the radial artery leaves the anterior part of the forearm, some distance above the carpus, and winds round the radius to the back of the limb. In this case the pulse cannot be felt at the wrist, at least on the radial side.

The radial artery is accompanied by venæ comites, one on each side of it. They require no particular description.

The relation of the Radial Nerve, Fig. 108 (16), to the radial artery, is such that it is required to be dissected and studied at the same time. It is, as has been seen, the anterior division of the musculo-spiral. It lies close to the inner side of the supinator longus in the upper two-thirds of the forearm, and is in direct relation with the radial artery only in the middle third. In the upper third the nerve proceeds from the outer part of the elbow, while the artery descends from the centre of the bend of the arm. From these points they converge so as to meet at the junction of the upper with the middle third. They separate again at the junction of the middle and lower thirds; the nerve passing beneath the supinator longus, and over the radius to reach the back part of the arm and hand. It is superficial in this part of its course. The nerve can generally be felt beneath the skin, during life, where it winds over the radius.

The radial nerve on the dorsum of the hand, Fig. 114 (4), divides into an external and an internal branch. The external branch supplies the integument on the outer and back part of the thumb, and anastomoses with the external cutaneous nerve. The internal branch passes obliquely over the extensor tendons of the thumb, and is distributed to the integument of the index and middle fingers, and sometimes to the radial side of the ring finger, and the ulnar side of the thumb. It anastomoses with the dorsal branch of the ulnar.

The Ulnar Artery, Fig. 112 (15), is situated on the inner side of the arm. Its upper third has an oblique direction from above downwards, and from without inwards, and is placed beneath the pronator radii teres, flexor carpi radi-

alis, palmaris longus, and flexor sublimis digitorum. The depth and direction of it in this part of its course should be observed. In the lower two-thirds of the forearm it is superficial, and situated on the radial side of the flexor carpi ulnaris, which may serve as a guide for finding it. The flexor sublimis lies on the outer side, and the flexor profundus behind it. The median nerve is separated from the artery at first by the coronoid head of the pronator radii teres, and below this it is situated to the outer side of it.

It gives off a recurrent branch, Fig. 112 (11, 18), which usually divides into an anterior and posterior. The *anterior* is small, and is distributed in front of the joint; the *posterior* is larger, and passes up beneath the flexor sublimis, to the notch between the olecranon process and internal condyle, where it meets with the ulnar nerve. It anastomoses with the inferior profunda and anastomotic branches of the brachial artery, and also sends small branches to the interior of the joint.

Just below the origin of the recurrent, it gives off the INTEROSSEOUS ARTERY, Fig. 112 (19). This soon divides into the anterior and posterior interosseous; the *former* passes down the forearm resting on the interosseous ligament, while the *latter* perforates the ligament, and is distributed to the muscles on the back of the limb. These will be examined at another time. There are no other branches given off from the ulnar, which are named, until it reaches the carpus, where it sends off a small *metacarpal branch*, which goes to the dorsum of the little finger, and *carpal branches*, which anastomose on the carpus, both in front and behind, with corresponding branches of the radial artery. The ulnar artery leaves the forearm by passing over the annular ligament close to the radial side of the pisiform bone, where it is covered by a few ligamentous fibres.

The ulnar, as was stated in connection with the bifurcation of the brachial artery, may commence at any point on the arm. An important anomaly is occasionally met with in its position; instead of passing beneath the muscles it may pass over them, or all of them except the palmaris longus. In this case it may be even superficial to the aponeurosis of the forearm. It also varies greatly in size; the interosseous or radial, or both of them, being at the same time larger or smaller than

common. It is important to understand the position of this artery in bleeding at the bend of the arm.

The ulnar artery is accompanied by its venæ comites.

The ULNAR NERVE, Fig. 113 (3), enters the forearm through the notch between the internal condyle and olecranon process, and between two heads of the flexor carpi ulnaris. It then passes obliquely beneath the inner head, to join the ulnar artery at the junction of the upper with the middle third of the forearm. It accompanies the artery in the rest of its course, being situated on the ulnar side. It sends articular filaments to the joint as it passes over it; muscular branches to the flexor carpi ulnaris, and flexor profundus digitorum; and cutaneous branches, one to the front of the lower part of the forearm and hand, and another to the dorsum of the same parts. The latter branch leaves it about two inches above the carpus, and passing beneath the flexor carpi ulnaris, Fig. 118 (6), gets round to the back of the wrist and hand, where it divides into several branches, which are distributed to the little and ring fingers. It also anastomoses with the radial.

Fig. 113.

A VIEW OF THE NERVES ON THE FRONT OF THE FOREARM.—1. The median nerve. 2. Anterior branch of the musculo-spiral or radial nerve. 3. The ulnar nerve. 4. Division of the median nerve in the palm to the thumb, first, second, and radial side of the third finger. 5. Division of the ulnar nerve to the ulnar side of the third, and both sides of the fourth finger.

The MEDIAN NERVE, Fig. 113 (1), after passing between the two heads of the pronator radii teres, goes down the middle of the forearm between the flexor sublimis in front, and the flexor profundus behind, to within about two inches of the wrist, where it gets on the outer side of the tendons of the flexor sublimis, and becomes superficial. It passes beneath the annular ligament to en-

ter the palm of the hand. It supplies branches to all the muscles on the front part of the forearm except the flexor carpi ulnaris. The anterior interosseous is the largest branch. The course of this is the same as that of the anterior interosseous artery, with which it will be noticed.

Three muscles remain to be dissected on the front of the forearm; these are the flexor profundus digitorum, flexor longus pollicis, and the pronator quadratus. The first two lie parallel to each other, and occupy the same plane; there is no very distinct line of demarcation or areolar interspace between them. The areolar tissue may be removed from the anterior surface of both of them at the same time.

Fig. 114.

The Flexor Profundus, or, Perforans Digitorum, Fig. 114 (4), *arises* from the upper two thirds of the ulna and the interosseous ligament contiguous to it, and sometimes by a small slip from the radius. It is a large muscle, occupying the inner two thirds of the anterior interosseous space; near the carpus it divides into four tendons, which pass beneath the annular ligament to go to the last row of phalangeal bones into which they are *inserted.* It flexes the last phalanges, and otherwise assists the flexor sublimis in flexing the fingers and hand.

The Flexor Longus Pollicis, Fig. 114 (5), *arises* from the radius, commencing just below the tubercle, and extending to within about two inches of its lower end; also from the interosseous ligament, and frequently by a

The Deep Layer of Muscles of the Forearm.—1. The internal lateral ligament of the elbow-joint. 2. The anterior ligament. 3. The orbicular ligament of the head of the radius. 4. The flexor profundus digitorum muscle. 5. The flexor longus pollicis. 6. The pronator quadratus. 7. The adductor pollicis muscle. 8. The dorsal interosseous muscle of the middle finger, and palmar interosseous of the ring finger. 9. The dorsal interosseous muscle of the ring finger, and palmar interosseous of the little finger.

round fasciculus from the coronoid process of the ulna. It ends in a tendon which passes beneath the annular ligament, and continues to the last phalangeal bone of the thumb, into which it is *inserted.* It flexes the last phalanx of the thumb.

The PRONATOR QUADRATUS, Fig. 114 (6), and 115 (9), is a short, square muscle, placed beneath the preceding muscles. It *arises* from the inner part of the lower fifth of the ulna; its fibres pass transversely, or nearly so, across the interosseous space, and are *inserted* into the lower part of the radius, near its outer border. It rotates the radius inwards, and thus pronates the hand.

Fig. 115.

A VIEW OF THE PRONATORS OF THE FOREARM.—1. Os humeri. 2. Radius. 3. Ulna. 4. Capsular ligament of the elbow. 5. Interosseous ligament. 6. Origin of the pronator radii teres. 7. Its insertion. 8. Supinator radii brevis. 9. Pronator quadratus. 10. Tendon of the biceps. 11. Carpal articulation.

The ANTERIOR INTEROSSEOUS ARTERY, Fig. 112 (19), may now be examined, and also its accompanying nerve. They usually rest on the interosseous ligament near the median line. The artery passes through the ligament near the pronator quadratus to the dorsum of the carpus, where it divides into several small branches. Occasionally it gives off quite a large branch, which accompanies the median nerve down the forearm.

The ANTERIOR INTEROSSEOUS NERVE, Fig. 108 (13), terminates in a filament to the pronator quadratus and one to the carpal articulations. Both the artery and nerve give off branches to the muscles which lie contiguous to them in the interosseous space.

The back of the forearm may now be examined, and, at the same time, the back of the hand. It is not necessary to refer again to the fascia or the subcutaneous vessels and nerves of this region, as they were described in connection with the anterior part of the forearm. The remarks which were made with reference to the study of the muscles on the

forepart of the forearm will apply equally to those on the back part. Most of them are antagonist muscles to those already learned. There are eleven, including the anconeus, and allowing no distinct muscle for the little finger. In arranging them according to their action, and comparing them with the flexors and pronators, the student will find two supinators opposed to the two pronators; three carpal extensors to the two carpal flexors; three extensors of the thumb, one for each joint, to the single long flexor; one common extensor of the fingers to the two common flexors. The extensor of the index finger and the anconeus have no corresponding muscles in front.

Six of these muscles are situated superficially, and may be dissected in the following order:—

The ANCONEUS, Fig. 116 (11), and Fig. 117 (4), is a small triangular-shaped muscle, situated on the posterior part of the elbow-joint. It *arises* from the external condyle of the humerus, immediately below the origin of the lower fibres of the triceps extensor, and from the external lateral ligament; it passes obliquely downwards and somewhat inwards, and is *inserted* into a triangular space on the upper and posterior part of the ulna. It assists the triceps in extending the arm, and might be considered an appendage to that muscle. It partly covers the elbow-joint posteriorly.

The SUPINATOR LONGUS, Fig. 116 (4), *arises* from the ridge which extends upwards from the external condyle, and from the external intermuscular septum of the brachial aponeurosis; its origin commences just below the insertion of the deltoid and ends about an inch and a half above the condyle. Its fibres terminate in a tendon about the middle of the forearm, which goes down to be *inserted* into the lower end of the radius at the base of the styloid process. It rotates the radius backwards so as to supinate the hand.

The EXTENSOR CARPI RADIALIS LONGIOR, Fig. 116 (5), *arises* from the external condyloid ridge, immediately below the preceding muscle, and becomes tendinous near the junction of the upper with the middle third of the forearm.

The EXTENSOR CARPI RADIALIS BREVIOR, Fig. 116 (6), *arises* from the external condyle, and from the aponeurosis which partly surrounds it. It becomes tendinous a little

lower down than the preceding muscle. The tendons of these two carpal extensors are partly covered by the supinator longus, and are so closely connected to each other that they appear to form a single tendon until they get near the wrist, where they separate, and, passing beneath the tendons of two of the extensor muscles of the thumb, and then through the same canal in the posterior annular ligament, are *inserted*, the longior into the base of the metacarpal bone of the index finger, and the brevior into the metacarpal bone of the second finger. They extend the hand on the forearm, and also abduct it. The groove which their tendons occupy in passing over the radius is lined by a bursa.

The EXTENSOR DIGITORUM COMMUNIS, Fig. 116 (8), is placed on the ulnar side of the muscles just described. It *arises* from the external condyle, from the aponeurosis around it, and from the ulna. About the middle of the forearm it divides into four small muscles, each of which ends in a tendon. The four tendons passing through a groove on the radius, and a canal beneath the annular ligament, expand on the back of the hand, being connected together more or less by tendinous fibres, and finally are *inserted* into all the phalanges. On the dorsum of the fingers they are connected with the tendons of the interossei and lumbri-

Fig. 116.

THE SUPERFICIAL LAYER OF MUSCLES OF THE POSTERIOR ASPECT OF THE FOREARM.—1. The lower part of the biceps. 2. Part of the brachialis anticus. 3. The lower part of the triceps, inserted into the olecranon. 4. The supinator longus. 5. The extensor carpi radialis longior. 6. The extensor carpi radialis brevior. 7. The tendons of insertion of these two muscles. 8. The extensor communis digitorum. 9. The extensor minimi digiti. 10. The extensor carpi ulnaris. 11. The anconeus. 12. Part of the flexor carpi ulnaris. 13. The extensor ossis metacarpi and extensor primi internodii muscles lying together. 14. The extensor secundi internodii; its tendon is seen crossing the two tendons of the extensor carpi radialis longior and brevior. 15. The posterior annular ligament. The tendons of the common extensor are seen upon the back of the hand, and their mode of distribution on the dorsum of the fingers.

cales. It extends all the fingers. The *extensor minimi digiti*, Fig. 116 (9), may be considered a part of this muscle, having the same origin, course, and insertion. Its tendon may pass through a separate canal beneath the annular ligament.

The EXTENSOR CARPI ULNARIS, Fig. 116 (10), *arises* from the external condyle, from the aponeurosis around it, and from the ulna below the insertion of the anconeus. It becomes entirely tendinous near the carpus, passes through a groove behind the styloid process of the ulna and a separate canal beneath the annular ligament, and is *inserted* into the base of the metacarpal bone of the little finger. It extends the hand, and adducts it. As an extensor, it acts in conjunction with the radio-carpal extensors; as an adductor of the hand it co-operates with the flexor carpi ulnaris, although, as an extensor, it opposes this muscle.

The student will meet with some difficulty in separating the extensor muscles in the upper part of the forearm, on account of their arising from the same aponeurosis and intermuscular septa. When they are separated from each other the dissection will necessarily appear rough and uneven.

The remaining five muscles on the back of the forearm are deep-seated, and, except the anconeus, small, compared with those which have been dissected. The *arteries* are the posterior interosseous and the radial, together with some small branches on the dor-

Fig. 117.

THE DEEP LAYER OF MUSCLES ON THE POSTERIOR ASPECT OF THE FOREARM.—1. The lower part of the humerus. 2. The olecranon. 3. The ulna. 4. The anconeus muscle. 5. The supinator brevis muscle. 6. The extensor ossis metacarpi pollicis. 7. The extensor primi internodii pollicis. 8. The extensor secundi internodii pollicis. 9. The extensor indicis. 10. The first dorsal interosseous muscle. The other three dorsal interossei are seen between the metacarpal bones of their respective fingers.

sum of the hand. The *nerves* are the posterior interosseous, and the cutaneous branches of the radial and ulnar on the lower part of the limb, which last were examined directly after the removal of the skin.

The Supinator Brevis, Fig. 117 (5), is a short flat muscle, which arises from the external condyle, the ulna for a short distance below the lesser sigmoid cavity, and the external lateral and orbicular ligaments. The fibres pass obliquely downwards and outwards, and are *inserted* into the radius between its cervix and the insertion of the pronator radii teres. To expose it, the supinator longus and the radio-carpal extensors must be divided a few inches below the elbow, and reflected upwards; the anconeus should also be dissected up.

The Posterior Interosseous Artery will be seen just below the supinator brevis. It descends to the wrist, lying on the extensor muscles of the thumb and index finger. It gives off, in the upper part of its course, the *posterior recurrent* branch, which ascends beneath the anconeus to anastomose with the superior profunda, and to send twigs to the elbow-joint. It supplies the muscles on the back of the forearm, and anastomoses on the dorsum of the wrist with branches from the radial, ulnar, and anterior interosseous arteries.

The Posterior Interosseous Nerve, Fig. 118 (2), will be found passing through the supinator brevis, and then descending with the artery to near the middle of the forearm, where it dips down to the interosseous ligament, on which it continues to the

Fig. 118.

A View of the Nerves on the Back of the Forearm and Hand.—1, 1. The ulnar nerve. 2, 2. Posterior interosseous nerve. 3. Humeral cutaneous branch. 4. Dorsal branch of the radial nerve. 5, 5. A back view of the digital nerves. 6. Dorsal branch of the ulnar nerve.

wrist. It terminates in filaments to the carpal articulations.

In its course it sends filaments to all the muscles on the back of the limb, except the supinator longus, extensor carpi radialis longior, and anconeus.

The Extensor Ossis Metacarpi Pollicis, Fig. 117 (6), is the first deep muscle below the supinator brevis. It arises from the posterior and upper part of the radius and ulna, and from the intermediate portion of the interosseous ligament. Its tendon descends obliquely outwards over the lower part of the radius, and the carpus to be inserted into the base of the metacarpal bone of the thumb. It very frequently divides into two tendons, one of which goes to the trapezium.

The Extensor Primi Internodii Pollicis, Fig. 117 (7), is the next small muscle. It *arises* from the radius and interosseous ligament, immediately below the preceding muscle, with which its tendon is closely connected. It is *inserted* into the base of the first phalangeal bone of the thumb. The line of separation between these two muscles is often very indistinct, except near their insertion. Their tendons pass through the same canal in the posterior annular ligament.

The Extensor Secundi Internodii Pollicis, Fig. 117 (8), *arises* from the middle third of the ulna and the interosseous ligament contiguous to it. Its tendon passes down over the lower end of the radius, about half an inch to the ulnar side of the tendons of the other two extensors of the thumb, and continues to the last phalanx, into which it is *inserted.* The last three muscles extend the three joints of the thumb; the first two also act as abductors of it. The student should observe the situation of the tendons of these muscles in his own wrist. They are seen very distinctly through the skin when the thumb is forcibly extended. They have an important relation to the radial artery, which passes beneath them, and which will shortly be noticed.

The Extensor Indicis, or Indicator, Fig. 117 (9), is the only muscle left. It *arises* from the ulna and interosseous ligament just below the muscle last described, and forms a small tendon which passes through the annular ligament with the common extensor of the fingers; it joins and is *inserted* in common with, the tendon of that muscle which is appropriated to the index finger. Its use is to extend that finger by itself.

The RADIAL ARTERY may now be examined in its course over the wrist. It winds round the external lateral ligament of the wrist-joint, below the radius, and enters a triangular space between the tendons of the extensor muscles of the thumb; leaving this space, where it is covered merely by the skin and fascia, it gets between the metacarpal bones of the thumb and index finger, and then disappears between the two heads of the first dorsal interosseous muscle, and enters the palm of the hand. It gives off the *dorso-carpal* branch, which passes transversely beneath the tendons, on the back of the wrist, to anastomose with the dorso-carpal branch of the ulnar. From the arch thus formed, branches pass up to anastomose with the interosseous arteries; others descend in the interosseous spaces to the fingers. The branch, in the second interosseous space, is sometimes quite large. Other small branches are given off from it to the back of the thumb and forefinger.

The canals in the posterior annular ligament may now be examined. There are six of them altogether. They are lined by synovial membrane so as to allow the tendons to glide through them with perfect facility, while each is kept in its proper place. The synovial membrane usually extends some distance above and below the ligament. Between the different openings the ligament is firmly attached to the bone beneath. The examination of the dorsal interosseous muscles may be postponed until the palm of the hand has been dissected.

THE PALM OF THE HAND.

To dissect the front part of the hand it should be placed with the palm upwards; the thumb and fingers should also be extended and fixed with hooks. It is immaterial in what direction the incisions are made for the purpose of removing the skin. In dissecting it from the inner part of the palm, it is to be recollected that the following muscle is inserted into the integument:—

The PALMARIS BREVIS *arises* from the annular ligament and palmar aponeurosis, and passes, in fasciculi, transversely inwards, and is *inserted* into the skin in front of the metacarpal bone of the little finger near the inner border of the

hand. Its action is to increase the depth of the hollow of the palm of the hand.

Two *cutaneous nerves*, one from the ulnar, and the other from the median, are distributed to the skin in the palm. These branches were noticed in the dissection of the median and ulnar nerves in the lower part of the forearm, as passing over the annular ligament to the hand.

Between the skin and the palmar fascia there is usually considerable fat, which must be dissected from the latter. The fascia is of a triangular shape, narrow above and broad below. It is attached to the annular ligament above; below it divides into four processes, one for each finger, and each of these again is subdivided into two others, which dip down to be inserted into the sheaths of the tendons of the flexor muscles of the fingers, and the ligaments of the joints beneath. The first mentioned processes are connected by transverse fibres, which form arches over the lumbricales and the digital arteries and nerves. The fascia is bound down by fibres which pass between the tendons to be attached to the metacarpal bones. It is very thin over the muscles of the thumb and little finger. This fascia should be noticed with reference to the formation of pus beneath it, and punctured wounds in the palm of the hand.

The SUPERFICIAL PALMAR ARCH, Fig. 112 (16), and its *branches*, are situated immediately beneath the palmar fascia. These, with the *branches* of the median and ulnar nerves, should be dissected next. The arch is readily exposed by following the ulnar artery, or the superficialis volæ, over the annular ligament. It is situated nearly in the centre of the palm, with its convexity looking towards the fingers. The principal branches from the arch are the four *metacarpal*. Three of these correspond respectively with the second, third, and fourth interosseous spaces, while the fourth one passes down to the ulnar side of the little finger.

Each of these arteries, except the one which goes to the ulnar side of the little finger, divides at the lower end of the space which it occupies, into *two digital branches;* these extend along the contiguous sides of the fingers to their extremities.

Those of the same finger anastomose freely with each other, especially in its pulpy portion. It usually requires some patience to dissect out these arteries in consequence of

the close adherence of cellulo-adipose substance to them. The superficial palmar arch is connected at its outer extremity with the superficialis volæ, and another branch which proceeds from the radial artery to the index finger. Besides the branches already mentioned, there are several smaller ones derived from this arch, but they require no special notice.

Although the radial artery cannot be traced at the present time into the deep palmar arch, its digital branches to the thumb and forefinger may now be exposed. They occupy a position on the thumb and radial side of the forefinger, similar to that of the other digital branches on the fingers. It will be observed that the index finger is supplied equally by the radial and ulnar arteries.

The ULNAR NERVE, Fig. 113 (5), will be found entering the palm along with the ulnar artery, but instead of forming an arch, it divides into a deep and superficial branch. The *deep* one passes deeply into the palm of the hand, and across it beneath the common flexor tendons to the muscles of the thumb. It perforates the short flexor of the little finger, and in its course supplies branches to the muscles of the little finger, the third and fourth lumbricales, and the corresponding interosseous muscles, terminating in the abductor indicis, adductor pollicis, and the inner head of the flexor brevis pollicis. The *superficial* one sends a branch to the inner side of the little finger, the short flexor of which it perforates. It then divides into two branches to supply the contiguous sides of the little and ring fingers; it also sends a small branch to join the median nerve.

The MEDIAN NERVE, Fig. 113 (4), enters the palm of the hand resting on the tendons of the long digital flexors. Having sent a branch to those muscles of the thumb which are not supplied by the deep branch of the ulnar, it divides into two parts, from which proceed five branches, to be distributed as follows:—

One branch goes to each side of the thumb; one to the radial side of the index finger; the other two subdivide each into two branches, to supply the opposing sides of the index, middle, and ring fingers. They are expended mainly in the skin, which, at the extremities of the fingers, is supplied by them on the dorsal as well as on the palmar aspect. The digital

arteries and nerves may be dissected at the same time. The nerves will be found to be more superficial than the arteries.

The tendons of the long flexors of the thumb and fingers, and the lumbricales, may now be examined.

Beneath the annular ligament the tendons are surrounded by the carpal bursæ, of which there are two; one for the tendons of the fingers, and one for the tendon of the thumb. The former projects between the different tendons, extends some distance above the annular ligament, especially behind, and is prolonged downwards in the form of four pouches, one for the two tendons of each finger. The bursa on the flexor tendon of the thumb extends much further, both above and below the annular ligament. A proper examination of this bursa requires a division of the annular ligament. This may be done now, or postponed until the muscles of the thumb and little finger have been dissected.

The tendons of the digital flexors, Fig. 119, pass down in front of the phalanges; those of the sublimis to the second, and those of the profundus to the last row. They are kept in place by sheaths, composed of a dense fibrous structure, which is firmly attached to the margins of the groove on the palmar aspect of each of the phalanges of the first and second rows. In front of the articulations these sheaths are deficient or entirely absent. Each of these fibrous canals is lined by a synovial membrane, which is reflected around the tendons.

The tendons of the flexor sublimis split, Fig. 119 (8), nearly opposite to the middle of each phalanx of the first row, and then reunite to be inserted into those of the second. The tendons of the flexor profundus pass through the openings thus formed; above the slits they lie behind the tendons of the sublimis, but get in front below them; they are inserted into the last row of phalanges.

The tendon of the flexor longus pollicis passes over the trapezium, and between the two heads of the flexor brevis pollicis, and through a fibrous sheath to be *inserted* into the last phalangeal bone of the thumb.

The Lumbricales, Fig. 119 (7, 7), are four small muscles which *arise* from the external sides of the tendons of the flexor profundus. Their tendons pass downwards and backwards over the radial side of the metacarpo-phalangeal

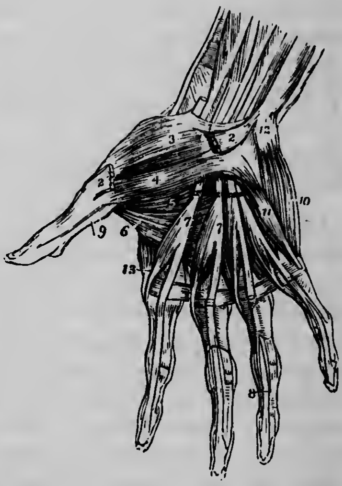
articulations, and are *expanded* on the back of the first row of phalanges, in connection with the tendons of the common extensor of the fingers. Their action cannot well be defined; it will depend on the action of other muscles, whether they assist in flexing or extending, in abducting or adducting the fingers.

The four short muscles of the thumb may now be dissected. They form the palmar or thenar eminence, and are named according to their action on the thumb.

The ABDUCTOR POLLICIS, Fig. 119 (2, 2), is the most superficial and external. It *arises* from the annular ligament and trapezium, and is *inserted* into the base of the first phalanx. It abducts the thumb.

The FLEXOR OSSIS METACARPI, or, OPPONENS POLLICIS, Fig. 119 (3), is partly overlapped by the preceding muscle, which, consequently, should be raised before the opponens

Fig. 119.



THE MUSCLES OF THE HAND.—1. The annular ligament. 2, 2. The origin and insertion of the abductor pollicis muscle; the middle portion has been removed. 3. The flexor ossis metacarpi. or opponens pollicis. 4. One portion of the flexor brevis pollicis. 5. The deep portion of the flexor brevis pollicis. 6. The adductor pollicis. 7, 7. The lumbricales muscles, arising from the deep flexor tendons, upon which the numbers are placed. The tendons of the flexor sublimis have been removed from the palm of the hand. 8. One of the tendons of the deep flexor, passing between the two terminal slips of the tendon of the flexor sublimis, to reach the last phalanx. 9. The tendon of the flexor longus pollicis, passing between the two portions of the flexor brevis to the last phalanx. 10. The abductor minimi digiti. 11. The flexor brevis minimi digiti. The edge of the flexor ossis metacarpi, or adductor minimi digiti, is seen projecting beyond the inner border of the flexor brevis. 12. The prominence of the pisiform bone. 13. The first dorsal interosseous muscle.

is dissected. It *arises* from the annular ligament and os scaphoides, and is *inserted* into the metacarpal bone of the

thumb. It opposes the thumb to the fingers, as in grasping anything in the palm.

The Flexor Brevis Pollicis, Fig. 119 (4, 5), is the largest of the four short muscles of the thumb. It consists of two parts, separated by the tendon of the flexor longus pollicis. The anterior part is not unfrequently inseparably connected with the opponens, and the posterior with the adductor pollicis. The *first arises* from the annular ligament, trapezium, and scaphoides; the *second* from the trapezoides, magnum, and base of the third metacarpal bone. The two parts unite and are *inserted* by two short tendons into the first phalanx. A sesamoid bone is commonly found in each of these tendons. As its name implies, it flexes the thumb.

The Adductor Pollicis, Fig. 119 (6), *arises* from the metacarpal bone of the middle finger, nearly its whole length, and is *inserted*, with the posterior part of the flexor brevis, into the first phalanx. It approximates the thumb to the forefinger.

There are three short muscles in the palm which belong to the little finger. They form the *hypothenar* eminence.

The Abductor Minimi Digiti, Fig. 119 (10), *arises* from the annular ligament and pisiform bone, and is *inserted* into the base of the first phalanx. It is the most superficial and internal of the short muscles of the little finger. It separates the little from the ring finger.

The Flexor Brevis Minimi Digiti, Fig. 119 (11), *arises* from the annular ligament and unciform bone, and is *inserted* into the first phalanx. It is closely connected to the abductor. It flexes the little finger.

The Adductor Minimi Digiti, Fig. 119 (11), *arises* from the os unciforme and annular ligament, and is *inserted* into the metacarpal bone of the little finger. It may be compared to the opponens pollicis. It lies behind the flexor brevis. It draws the little to the ring finger.

The annular ligament may now be examined and divided, and the tendons of the long flexors with the lumbricales removed from the palm, so as to expose the deep palmar arch and the interosseous muscles.

The Annular Ligament, Fig. 119 (1), is attached on the inner side to the pisiform bone, and the tendon of the flexor

carpi ulnaris, and also to the unciform bone; the ulnar nerve passes between these attachments. Externally it is connected to the scaphoides and trapezium. Its fibres are, for the most part, transverse. Its connection with the aponeuroses of the forearm and palm, and with the palmaris longus, and the short muscles of the thumb and little finger have already been seen. It subtends the deep sulcus in the anterior part of the carpus, and serves to keep the flexor tendons which pass beneath it in their proper place; it also strengthens the carpus.

The RADIAL ARTERY reaches the palm of the hand by passing between the heads of the abductor indicis. Before terminating in the deep palmar arch, it gives off a *digital* branch to the index finger, and the *arteria magna pollicis*, Fig. 118 (17), which divides into two branches for the thumb. The *former* will be found passing behind the flexor brevis pollicis and adductor pollicis, and over the abductor indicis; the *latter* passes between the abductor indicis and short flexor of the thumb. Their distribution was seen in the dissection of the branches of the superficial arch.

The DEEP PALMAR ARCH rests on the metacarpal bones and interosseous muscles, to which, and the carpus, it sends small branches. *Three metacarpal branches* are sent downwards from it along the interosseous spaces to anastomose with the digital branches of the superficial arch. It ends on the ulnar side by joining a deep branch from the ulnar artery.

The *deep branch* of the ulnar nerve may be traced at the same time with the deep palmar arch.

There are SEVEN INTEROSSEOUS MUSCLES—three palmar, and four dorsal. They occupy the spaces between the metacarpal bones, being separated from each other by a thin aponeurosis. The three palmar are called adductors, because they approximate the forefinger and the little and ring fingers to the middle finger, which is made to represent the median line of the hand.

The *adductor of the forefinger*, Fig. 120 (1), *arises* from the ulnar side of the upper and front part of the second metacarpal bone, and is *inserted* into the first phalanx of the forefinger.

The *adductor of the ring finger*, Fig. 120 (2), *arises* from the

radial side of the *fourth* metacarpal bone, and is *inserted* into the first phalanx of the ring finger.

The *adductor of the little finger*, Fig. 120 (3), *arises* from the radial side of the fifth metacarpal bone, and is *inserted* into the first phalanx of the little finger.

The arrangement of the four dorsal interosseous muscles is quite different. Two of them are abductors, while the other two act on the middle finger. Each one arises by two heads.

The *abductor of the forefinger*, Fig. 121 (1), *arises* from the first and second metacarpal bones, and is *inserted* into the base of the first phalanx of the index finger.

Fig. 120.

THE PALMAR INTEROSSEOUS MUSCLES ARE SHOWN IN CONNECTION WITH THE BONES OF THE RIGHT HAND.

Fig. 121.

THE DORSAL INTEROSSEOUS MUSCLES OF THE RIGHT HAND, AND THEIR CONNECTION WITH THE TENDONS OF THE LONG EXTENSOR MUSCLES OF THE FINGERS, ARE HERE REPRESENTED.

The *abductor of the ring finger*, Fig. 121 (4), *arises* from the fourth and fifth metacarpal bones, and is *inserted* into the first phalanx of the ring finger.

The *other two arise*, Fig. 121 (2, 3), *one* from the second and third, and the *other* from the third and fourth metacarpal bones; they are both *inserted* into the first phalanx of the middle finger. It will be observed that these are the only

interosseous muscles appropriated to the middle finger. One will move it towards the forefinger, and the other towards the ring finger. The terms "abductor" and "adductor" cannot be applied to these two muscles, unless it is done with reference to the median line of the body.

The tendons of the interosseous muscles are connected to those of the long extensors of the fingers, and serve to keep the latter applied to the dorsal surface of the phalanges; thus supplying the place of fibrous sheaths. When the fingers are flexed, they lose the power of abducting or adducting them. They contribute to the strength of the metacarpo-phalangeal articulations. The adductor and abductor of the thumb differ from those of the fingers in having no attachment to its metacarpal bone. The fibres of the adductor pollicis have a direction nearly transverse to the axis of the thumb, which adds greatly to the power of this muscle.

The remaining articulations of the upper extremity may now be examined.

The ELBOW-JOINT is formed by the humerus above, and the ulna and radius below. The radius and ulna also articulate with each other so as to form a movable joint. The articular surface of the humerus is adapted to flexion of the forearm, and, at the same time, allows the radius to rotate on the ulna. Thus it will be seen that this articulation admits of two distinct movements. It contains only one synovial membrane, which lines the inner surface of the parietes of the joint. The ligaments are the following:—

The EXTERNAL LATERAL LIGAMENT, Fig. 123 (4), arises from the external condyle of the humerus, passes downwards, and is inserted into the annular ligament.

The INTERNAL LATERAL LIGAMENT, Fig. 122 (2), arises from the internal condyle of the humerus; its fibres diverge as they pass downwards to be inserted into the base of the coronoid process of the ulna.

The ANTERIOR LIGAMENT, Fig. 123 (7), is thin and membranous. Its fibres arise from the margin of the fossa for the reception of the coronoid process of the ulna, pass downwards in front of the joint, and are inserted into the

coronoid process, and the annular ligament. The removal of this ligament affords a very good view of the interior of the joint.

Fig. 122.

An Internal View of the Elbow-Joint.—1. The anterior ligament. 2. The internal lateral ligament. 3. The coronary ligament. 4. The ligamentum teres. 5. The interosseous ligament. 6. The internal condyle, which conceals the posterior ligament behind.

Fig. 123.

An External View of the Elbow-Joint.—1. The humerus. 2. The ulna. 3. The radius. 4. The external lateral ligament. 5. The coronary ligament. 6. The insertion of the coronary ligament at the posterior part of the lesser sigmoid cavity of the ulna. 7. The anterior ligament. 8. Tho posterior ligament. 9. The interosseous ligament of tho forearm.

The Posterior Ligament, Fig. 123 (8), consists of but little more than condensed areolar tissue. The fibres which it contains pass in different directions between the humerus and the ulna.

The Annular or Orbicular Ligament, Fig. 122 (3), surrounds the cervix of the radius. It is attached to the extremities of the small sigmoid cavity of the ulna. The synovial membrane is prolonged from the upper part of the joint

downwards between this ligament and the cervix. Thus the cervix of the radius, as well as the head, it will be observed, is covered with synovial membrane. This should be noticed with reference to the occurrence of fracture in this part of the radius.

The ROUND OR OBLIQUE LIGAMENT, Fig. 122 (4), consists of a small fasciculus, which extends from the coronoid process obliquely downwards, to be inserted into the radius, just below its tubercle.

The INTEROSSEOUS LIGAMENT OR MEMBRANE, Fig. 122 (5), is composed of fibres which extend from the inner border of the shaft of the radius obliquely downwards to the opposite border of the ulna. It gives attachment on both of its surfaces to muscles, and is perforated for the passage of vessels and nerves.

The radius and ulna, at their inferior extremities, are connected to each other by a FIBRO-CARTILAGE, Fig. 125 (8), which extends from the styloid process of the ulna to the inner border of the radius, between its carpal and ulnar articular surfaces. The anterior and posterior borders of this fibro-cartilage are attached to the radio-carpal ligaments. The synovial membrane between the radius and ulna is sometimes called the *sacciform membrane* or *ligament*, Fig. 125 (1). It is strengthened by anterior and posterior fibres, which pass from one bone to the other.

The radius and ulna are joined to the carpus by an external and an internal lateral, and an anterior and a posterior ligament.

The EXTERNAL LATERAL LIGAMENT, Fig. 124 (4), arises from the styloid process of the radius, and is inserted into the scaphoides and trapezium, and the annular ligament.

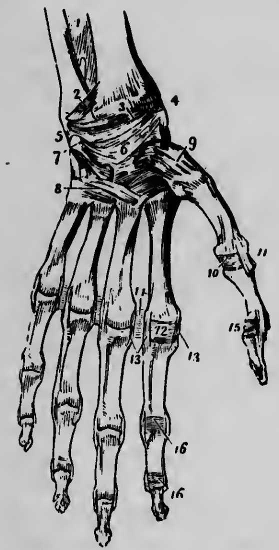
The INTERNAL LATERAL LIGAMENT, Fig. 124 (5), arises from the styloid process of the ulna, and is inserted into the cuneiform and pisiform bones.

The ANTERIOR LIGAMENT, Fig. 124 (3), arises from the anterior border of the lower end of the radius, and from the ulna, and is inserted into the scaphoid, semilunar, and cuneiform bones.

The POSTERIOR LIGAMENT arises from the radius and ulna

behind, and is inserted into the semilunar and cuneiform bones.

Fig. 124.



The Ligaments of the Anterior Aspect of the Wrist and Hand.—1. The lower part of the interosseous membrane. 2. The anterior inferior radio-ulnar ligament. 3. The anterior ligament of the wrist joint. 4. Its external lateral ligament. 5. Its internal lateral ligament. 6. The palmar ligaments of the carpus. 7. The pisiform bone with its ligaments. 8. The ligaments connecting the second range of carpal bones with the metacarpal and the metacarpal with each other. 9. The capsular ligament of the carpo-metacarpal articulation of the thumb. 10. Anterior ligament of the metacarpo-phalangeal articulation of the thumb. 11. One of the lateral ligaments of that articulation. 12. Anterior ligament of the metacarpo-phalangeal articulation of the index finger; this ligament has been removed in the other fingers. 13. Lateral ligaments of the same articulation; the corresponding ligaments are seen in the other articulations. 14. Transverse ligament connecting the heads of the metacarpal bones of the index and middle fingers; the same ligament is seen between the other fingers. 15. Anterior and one lateral ligament of the phalangeal articulation of the thumb. 16, 16. Anterior and lateral ligaments of the phalangeal articulations of the index finger; the anterior ligaments are removed in the other fingers.

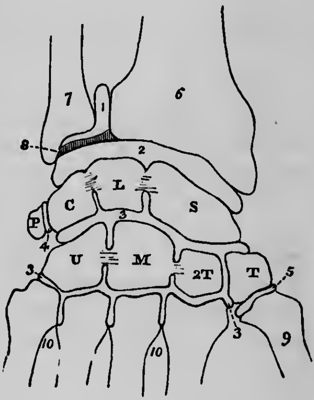
The carpus is composed of eight bones, arranged in two rows; there being four in each row. The bones in the upper row, except the pisiform, are connected together by *two dorsal* and *two palmar transverse ligaments*, and also by *two interosseous fibro-cartilages.* The pisiform is connected by a *capsular ligament* to the cuneiform, and by *ligamentous fibres* to the unciform and fifth metacarpal bone. The bones of the lower row are joined together by *three dorsal*, and *three palmar transverse ligaments*, and *two interosseous fibro-cartilages.*

The two rows are connected to each other by *dorsal* and *palmar*, and *external* and *internal lateral ligaments.* The *dorsal* and *palmar ligaments* consist of fibres which pass obliquely from the bones of one row to those of the other.

The *external lateral ligament* extends from the scaphoid to the trapezium. The *internal lateral ligament* connects the cuneiform and unciform bones.

The trapezium is connected to the metacarpal bone of the thumb by a *capsular ligament.* This articulation allows to

Fig. 125.



A DIAGRAM SHOWING THE DISPOSITION OF THE FIVE SYNOVIAL MEMBRANES OF THE WRIST-JOINT.—1. The sacciform membrane. 2. The second synovial membrane. 3, 3. The third, or large synovial membrane. 4. The synovial membrane between the pisiform bone and the cuneiform. 5. The synovial membrane of the metacarpal articulation of the thumb. 6. The lower extremity of the radius. 7. The lower extremity of the ulna. 8. The inter-articular fibro cartilage. S. The scaphoid bone. L. The semilunar. C. The cuneiform; the interosseous ligaments are seen passing between these three bones and separating the articulations of the wrist (2) from the articulation of the carpal bones (3). P. The pisiforme. T. The trapezium. 2T. The trapezoides. M. The os magnum. U. The unciform interosseous ligaments are seen connecting the os magnum with the trapezoides and unciform. 9. The base of the metacarpal bone of the thumb. 10, 10. The bases of the other metacarpal bones.

the thumb a great degree of motion. The metacarpal bones of the fingers are connected to the carpus by *dorsal* and *palmar ligaments.* The former are stronger than the latter.

The metacarpal bones are united at their carpal extremities by *dorsal* and *palmar transverse ligaments*, and also by *interosseous fibres.* Their phalangeal extremities are connected to each other by *three loose transverse fibrous bands.*

Each metacarpal bone is connected to its corresponding phalangeal bone by an *anterior* and *two lateral ligaments.* The anterior ligament is joined to the lateral ligaments on its sides. Anteriorly it is grooved for the tendons of the flexor muscles of the fingers, the sheaths of which are attached to it on each side of the groove. The lateral ligaments of the thumb are very strong, and sometimes contain sesamoid bones.

The articulations of the phalangeal bones have each an *anterior* and *two lateral ligaments.* They require no particular description.

The synovial membranes, Fig. 125, about the wrist should be carefully examined. There are five distinct capsules.

The large extent of articular surface in the carpus, is deserving of notice. The different joints should be opened by the student. This can be done after the soft parts have been dissected, without injuring the bones.

SECT. V.—DISSECTION OF THE SPINAL CANAL AND ITS CONTENTS.

To lay open the spinal canal, the soft parts which cover the lamellæ of the vertebræ should be entirely removed. When this has been done, a mallet and sharp chisel may be used for dividing the lamellæ on each side of the spinous processes; or, instead of the chisel, a saw may be used for this purpose. Bone-nippers will also sometimes be found useful. The ligamentous attachments must be severed with the scalpel. The vertebral column should be made as convex, posteriorly, as possible, by placing blocks underneath the subject. If the calvaria and the posterior part of the occipital bone have been removed before opening the canal, the student will be able to obtain a very satisfactory view of the relations of the parts in the spinal canal to those in the cranial cavity.

The contents of the spinal canal are the following: The dura mater, the arachnoid, the pia mater, the spinal cord, the roots of the spinal nerves, the spinal ganglia, and the intra-spinal vessels.

The DURA MATER of the cord has the same structure as that of the brain, with which it is continuous through the occipital foramen; it has not, however, the same uses. It does not form an internal periosteum to the walls of the spinal canal, nor does it furnish sinuses for the transmission of venous blood, or send off processes to support different parts of the spinal marrow.

It is separated from the parietes of the canal, more or less, by a soft, reddish, adipose and areolar tissue, and by plexuses of veins. It has fibrous attachments to the posterior common spinal ligament. Its external surface is generally smooth. In size it corresponds to the cord, being larger in the neck and the loins than elsewhere. It gives off processes, which surround the nerves as they pass through the intervertebral foramina. The lower part of it is divided into tubular pro-

longations, which contain the sacral nerves as they extend some distance in the canal before leaving it. Below it sends down a small fibrous cord, which is attached to the walls of the lower part of the sacral canal. It is more fixed in the anterior than in the posterior part of the canal, by its attachments to the posterior common spinal ligament.

The ARACHNOID lines the internal surface of the dura mater, and also invests the cord. It is exposed by slitting open the dura mater in the median line, through its whole length. It is continuous with the arachnoid of the brain, to which it is similar in structure and function. The visceral portion is connected to the parietal by tubular prolongations around the roots of the nerves.

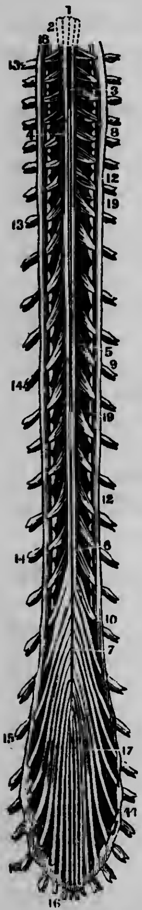
It is separated from the pia mater by the *subarachnoid space*, which is occupied by cellulo-fibrous tissue and a fluid. The fibrous structure is most abundant in the middle line behind, where it forms an imperfect septum. If this space be punctured in a living animal, the subarachnoid fluid escapes in a jet, causing, for a time, stupefaction of the animal. The principal use of this fluid is, probably, to protect the spinal marrow. A serous exhalation takes place from both surfaces of the arachnoid membrane, where it invests the cord.

The PIA MATER surrounds and adheres closely to the spinal cord. It is continuous with that of the brain, from which, however, it differs in structure, being more dense and fibrous, and less vascular. It sends prolongations into the anterior and posterior fissures of the cord, and also along the roots of the nerves. It terminates below, after furnishing sheaths for the nerves, in a fibrous cord, which descends to the sacrum, where it is attached to the dura mater.

The LIGAMENTUM DENTICULATUM, Fig. 126 (19), is found on each side of the cord, and between the anterior and posterior roots of the nerves; it reaches from the occipital foramen to the first lumbar vertebra. Its inner border is straight, and appears to be blended with the pia mater; while its outer border presents a series of tooth-like processes, which are attached to the dura mater in the spaces between the foramina which give exit to the nerves. In the upper part of the canal the spinal accessory nerve lies behind it. The serrated processes number twenty one or two. It separates the roots of the nerves and prevents lateral movement of the cord.

The intra-spinal vessels consist of those which supply the walls of the canal, and the cord, including its membranes.

Fig. 126.



The ARTERIES are derived from the vertebral, the intercostal, the lumbar, and the lateral sacral. Those which are denominated the *anterior* and *posterior spinal arteries* arise from the vertebral near the occipital foramen. There are two posterior and one anterior. They supply, principally, the upper part of the cord. The remaining arteries enter the canal through the intervertebral foramina, and reach the cord by passing along the roots of the nerves. There are usually three or four branches much larger than the others. These form a free anastomosis with the anterior and posterior spinal arteries.

The VEINS of the cord leave the canal by passing through the occipital and intervertebral foramina. Those which enter the cranial cavity terminate in the sinuses of the dura mater; the others are connected with the sacral, the lumbar, the intercostal, and the vertebral veins. There are several plexuses of veins in the spinal canal outside of the dura mater. These are designated the *anterior*, the *lateral*, and the *posterior plexuses*. There are two plexuses which extend the whole length of the canal. They are situated on the posterior surface of the bodies of the vertebræ, one on each side of the posterior common ligament. These plexuses all communicate freely with each other.

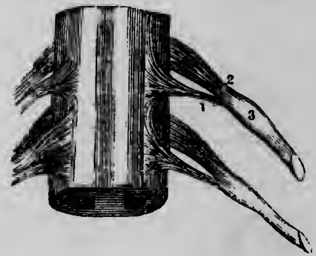
AN ANTERIOR VIEW OF THE SPINAL MARROW, SEEN IN ITS WHOLE LENGTH, AFTER REMOVAL FROM THE SPINAL CANAL.—1. Lines indicating the corpora pyramidalia. 2. Corpora olivaria. 3. Anterior face of the spinal marrow. 4. Anterior roots of the cervical spinal nerves. 5. Anterior roots of the dorsal nerves. 6. Anterior roots of the lumbar nerves. 7. Anterior roots of the sacral nerves. 8, 9, 10, 11. The anterior and posterior roots of the spinal nerves, united to pass out of the dura mater. 12. Dura mater of the medulla spinalis. 13. Ganglia on the cervical nerves. 14. Ganglia on the dorsal nerves. 15. Ganglia on the lumbar nerves. 16. Ganglia on the sacral nerves. 17. Cauda equina. 18. Sub-occipital nerve. 19. Ligamentum denticulatum.

The Medulla Spinalis, or Spinal Cord.

The spinal cord, Fig. 126, extends from the occipito-atlantoid articulation, to the first lumbar vertebra; being from sixteen to eighteen inches in length. It is much smaller than the spinal canal. It is not of equal size throughout its whole length. Those portions which correspond to the roots of the nerves that supply the upper and lower extremities, are the largest. It terminates below in the *cauda equina*, Fig. 126 (17), which consists of nervous cords.

The cord presents, externally, an *anterior* and a *posterior median fissure*, Fig. 128, which divide it, externally, into two distinct lateral columns. The pia mater enters these fissures. The anterior one is the widest, while the posterior is the deepest. A *lateral fissure* is observed where the posterior roots of the nerves are attached to the cord. This fissure divides each half of the cord into an antero-lateral, and a posterior column. Another lateral fissure has been described, corresponding to the anterior roots of the nerves; this, however, is scarcely perceptible.

Fig. 127.



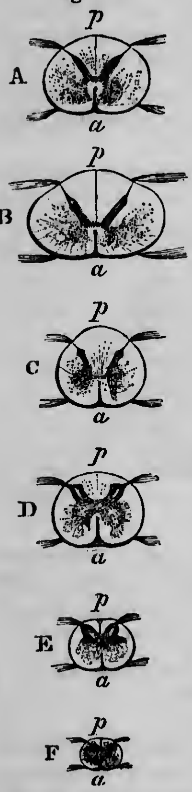
A View of a Small Portion of the Spinal Marrow, showing the Origins of some of the Spinal Nerves.—1. The anterior or motor root of a spinal nerve. 2. The posterior or sensor root of a spinal nerve. 3. The ganglion connected with the latter.

When a transverse section of the cord is made, each half is seen to consist, internally, of gray substance, Fig. 128. This is arranged so as to present a semilunar form, the cornua of which correspond to the anterior and posterior roots of the nerves. The posterior cornu reaches the external surface of the cord, but the anterior, which is the shortest and thickest of the two, does not. From this arrangement of the gray substance each half of the cord may be said to consist of three columns, the antero-lateral being divided into two by the anterior cornu. *Vesicular matter* exists in both cornua, but is most abundant in the

posterior. The gray substance in the anterior cornu has been called the *substantia gelatinosa;* and that in the posterior, the *substantia spongiosa.*

The two halves of the cord are united by a *gray commissure* at the bottom of the posterior median fissure, and a *white commissure* at the bottom of the anterior median fissure.

Fig. 128.



The relative proportions of the gray and white substance vary somewhat in different sections of the cord.

The precise manner in which the spinal nerves are connected with the substance of the cord, is not well understood. The anterior and posterior roots approach each other as they proceed from the cord to the foramina in the dura mater, Fig. 126 (8, 9, 10, 11), through which they pass separately. The posterior root or fasciculus of each nerve enters a *ganglion*, Fig. 127 (3), in the intervertebral foramen; and almost immediately after passing through the ganglion it joins the anterior fasciculus, and is inclosed with it in the same neurilemma, which is derived from the dura mater. The fasciculi increase in length from above downwards before they perforate the fibrous sheath of the cord.

The posterior roots are *sensor*, and are larger than the anterior, which are *motor*, Fig. 127 (1, 2). Each set is supposed to contain filaments, which belong to both the excito-motor and the cerebro-spinal system of nerves.

Transverse Section of the Spinal Cord.—A. Immediately below the decussation of the pyramids. B. At middle of cervical bulb. C. Midway between cervical and lumbar bulbs. D. Lumbar bulb. E. An inch lower. F. Very near the lower end. *a*. Anterior surface. *p*. Posterior surface. The points of emergence of the anterior and posterior roots of the nerves are also seen.

CHAPTER II.

SECT. I.—DISSECTION OF THE THORAX.

THE thorax is *situated* between the neck above, the abdomen below, and the upper extremities laterally. The *solid parietes* of the thoracic cavity consist of the sternum and costal cartilages in front, of the ribs laterally, and the dorsal vertebræ, with the posterior extremities of the ribs behind.

The *shape* of the thorax is that of a truncated cone, indented behind by the spinal fossæ. Its *base* is oblique, sloping from the xiphoid cartilage downwards and backwards to the first lumbar vertebra. Its *apex* is also oblique, but from before upwards and backwards to the last cervical vertebra; hence the vertical diameter of the thoracic cavity is much greater behind than before.

The *spaces* between the ribs are occupied by aponeurosis and the intercostal muscles, which are perforated by branches of the intercostal arteries and nerves, and by branches of the internal mammary arteries.

The *upper orifice* of the thoracic cavity is broader transversely than from behind forwards. Its boundaries are formed, in front, by the upper border of the sternum, on each side by the first rib, and behind, by the first dorsal vertebra. It transmits the œsophagus, the trachea, the thoracic duct, the pneumogastric, phrenic, and sympathetic nerves, and the large arteries and veins of the head, neck, and upper extremities; the superior intercostal and internal mammary arteries, with the recurrent laryngeal nerves, also pass through it. Besides the parts just enumerated, and the thoracic fascia, which surrounds and connects them together, the apex of each lung, with the pleura and several muscles, are included in this opening.

The *lower orifice* is four or five times larger than the upper, and is liable to much greater variation in size. It is bounded in front by the xiphoid cartilage, laterally by the lower six

ribs and their cartilages, and behind, by the last dorsal vertebra. Its circumference embraces the upper abdominal viscera, as the liver, the stomach, the spleen, &c. The diaphragm, which forms the septum between the abdominal and thoracic cavities, is attached to nearly the whole of its margin. The œsophagus, the thoracic duct, the pneumogastric, sympathetic, and splanchnic nerves, the aorta, the ascending vena cava, and the azygos vein, pass through the diaphragm.

The intercostal muscles should be examined before the cavity of the thorax is opened. They consist of two sets, the internal and external.

The EXTERNAL INTERCOSTALS, Fig. 147 (4), extend from the vertebral articulations of the ribs to the costal cartilages. They *arise* from the outer lip of the lower border of each rib, except the last, pass obliquely downwards and forwards, and are *inserted* into the corresponding lip of the upper border of each rib, immediately below their origin.

The INTERNAL INTERCOSTALS, Fig. 147 (5), extend from the angles of the ribs to the sternum. They *arise* from the inner lip of the lower border of each rib and its cartilage, except the last, pass downwards and somewhat backwards, and are *inserted* into the upper border of each rib, below their origin. An *aponeurosis* extends from the external to the sternum, and also from the internal to the costo-vertebral articulations. A considerable portion of each of the intercostal muscles is tendinous, or aponeurotic. Their fibres have the same direction, respectively, as those of the external and internal oblique muscles of the abdomen. The intercostal arteries and nerves pass between them. They act as muscles of inspiration or expiration, according as the first rib, or the lower ribs be fixed. The crossing of them adds to the strength of the thoracic parietes.

The cavity of the thorax may now be opened for the study of its contents. This may be done in several ways. If it be wished to preserve the skeleton, the student can obtain a very good idea of the thoracic viscera and their relations by adopting the following method:—

Saw through the sternum in the median line, taking care not to injure the soft parts underneath it. Then divide the intercostal muscles, and separate the costal cartilages, on each

side, from the ribs; the pleura may be divided at the same time, as this will not interfere with the study of it afterwards.[1] By carefully separating the two halves of the sternum, a space will be observed behind it, bounded laterally by the pleuræ; and, by raising the cartilages on each side, the manner in which this space is formed will be readily understood, by observing that each pleura is reflected from the posterior surface of the sternum backwards. It will be noticed that, as the pleuræ leave the sternum, they are, in the centre, very nearly in apposition, leaving scarcely any space between them, while above and below they are separated a short distance from each other. The left pleura is reflected from the lower part of the sternum obliquely downwards, and to the left side.

One half of the sternum, with the cartilages attached to it, may now be raised, commencing at its upper extremity, and reflected downwards over the abdomen without detaching it from the diaphragm. In raising it, the origin of the sterno-thyroideus, and sometimes that of the sterno-hyoideus, the internal mammary artery, the triangularis sterni muscle, and the intercostal nerves, will be seen.

The TRIANGULARIS STERNI MUSCLE is situated behind the sternum and costal cartilages. It *arises* from the side of the sternum and xiphoid cartilage, and some of the costal cartilages close to the sternum. It divides into several digitations, which are *inserted* into the second, third, fourth, fifth, and sixth ribs. The lower fibres have nearly a transverse direction, and are continuous with the transverse muscle of the abdomen; the upper fibres pass obliquely upwards and outwards. Its action is to draw down, or to fix the costal cartilages.

The INTERNAL MAMMARY ARTERY arises from the subclavian opposite to the supra-scapular, and passes obliquely downwards behind the sternal extremity of the clavicle and cartilage of the first rib, where it enters the cavity of the

[1] A partial view of the contents of the thoracic viscera may be obtained by simply dividing the sternum in the median line, and separating the two halves by means of dilators made for the purpose, or by any means which may be most convenient. To make a thorough examination of the contents of the thoracic cavity, it is necessary to cut away, more or less, the ribs.

thorax. In this part of its course, the phrenic nerve crosses it superficially from without inwards. Its course in the thorax is nearly parallel with, and about one-third of an inch from, the border of the sternum. It is situated between the costal cartilages in front and the pleura and triangularis sterni muscle behind. At the sixth intercostal space it divides into two branches, external and internal.

The *internal division*, which is generally regarded as a continuation of the artery, passes beneath the cartilage of the seventh rib, and pierces the sheath of the rectus abdominis muscle. It supplies the upper and anterior parietes of the abdomen, and inosculates with branches of the epigastric, thus connecting the external iliac and subclavian arteries.

The *external branch*, or *musculo-phrenic*, goes obliquely downwards and outwards to the eleventh intercostal space, giving off, in its course, branches to the diaphragm, and to the intercostal and abdominal muscles. Its branches inosculate, with the lower intercostal arteries, from the aorta.

The internal mammary artery, before it divides, gives off the following branches:—

The *anterior intercostals* are directed outwards, in the intercostal spaces; they inosculate with the aortic intercostals. There are frequently two in each space.

The *anterior*, or *perforating branches*, pierce the internal intercostal and pectoralis major muscles. They are distributed to these muscles, and to the integuments and mammary gland, and inosculate with branches from the axillary artery.

The *mediastinal branches* are distributed to the remains of the thymus gland, and other parts in the mediastinal space.

A branch—*comes nervi phrenici*—accompanies the phrenic nerve to the diaphragm, giving branches in its course to the pericardium. The internal mammary artery has two *venæ comites*.

The Anterior Cutaneous Branches of the upper intercostal nerves may be seen where they perforate the internal intercostal and pectoralis major muscles near the sternum, to reach the integument.

There are *three serous sacs* in the thoracic cavity—one for each lung, and one for the heart. The necessity of each of these organs having appropriated to it a serous membrane

will be understood when it is considered that they are subjected to more or less motion. Each sac is divided into a visceral and a parietal portion. The first is applied closely to the external surface of the organ, while the other lines the inner surface of the cavity which contains it. Thus two smooth surfaces are opposed to each other, which are constantly lubricated with serum, so that no friction is caused by their movements upon each other.

The Pleura.

The student should now carefully trace the reflections of the pleura for himself, and observe its relations to the contiguous parts, and to the external surface of the body. The pleural cavity has been exposed by separating the costal cartilages from the ribs, and raising them on one side with the corresponding half of the sternum. It will be observed that as the pleura is reflected from the posterior surface of the sternum, it proceeds almost directly backwards to the vertebral column.

The corresponding portions of the two pleuræ form a septum between the pleural cavities, called the *mediastinum.* The lower part of this septum is inclined somewhat to the left side on account of the position of the heart. That portion of each pleura concerned in forming the mediastinum is called the *pleura mediastinalis.* As this is traced from the sternum backwards, it will be found in the upper part of the thorax to pass almost directly to the vertebræ, while in the middle and lower parts it is reflected outwards over the pericardium, to which it closely adheres, except where it covers the phrenic nerve. As it proceeds backwards it is, near the middle of the mediastinum, reflected round the root of the lung, from which it is extended over the entire lung, forming the *pleura pulmonalis.*

In the lower part it forms a fold extending from the root of the lung to the diaphragm, called the *ligamentum latum pulmonis.* This fold is of a triangular shape, with the apex towards the root of the lung. If the lungs be drawn forwards it will be seen that the pleuræ approach each other as

they are reflected from the roots of the lungs and the pericardium to the vertebral column.

The pleura mediastinalis is continuous below, with the *pleura diaphragmatica*, and laterally with the *pleura costalis*. The former lines the thoracic surface of the diaphragm; the latter covers the inner surface of the ribs and intercostal spaces, the internal mammary and intercostal arteries, the splanchnic, sympathetic and intercostal nerves, and the dorsal ganglia of the sympathetic.

The pleura is prolonged from half an inch to an inch above the first rib, where it covers the posterior surface of the lower part of the scalenus anticus muscle, and the subclavian artery. It usually extends somewhat higher on the right side than on the left. Small masses of fat, similar to the appendices epiploicæ on the colon, are sometimes observed on the mediastinal and diaphragmatic portions.

The pleura pulmonalis lines the fissures which separate the lobes of the lung. It is very thin and elastic. The inner or fibrous layer is connected with the parenchyma of the lung. The air will generally escape through it from the cells when the lungs are removed from the thorax and inflated. The fibrous layer of the costal pleura is thicker than that of either of the other portions, and more easily detached from the subjacent tissues.

The shape of the cavity formed by the parietal pleura is the same as that of the lung which fills it. The left one is longer than the right, but not so broad. Abscesses rarely open into the pleural cavities, either from the lungs or from the surrounding parts.

Having examined the pleura, the student should now proceed to the study of the contents of the *mediastinal space*.

The boundaries of this space are on each side the mediastinal pleura, in front the sternum, behind the vertebral column, below the diaphragm, and above the upper orifice of the thorax. To facilitate the study of the organs, especially of their position in the thorax, contained in this space, it will be found convenient to divide it into four parts; and as the heart is the principal organ in point of size in it, it naturally forms the basis of this division.

Observing its position, or that of the pericardium, the student will have no difficulty in understanding these divisions.

The *anterior* is situated between the heart and the sternum; the *posterior* between the heart and the spinal column; the *superior*, between the heart below, and the upper orifice of the thorax above, the sternum in front, and the spinal column behind; while the heart and pericardium occupy the *middle*. The mediastinal pleuræ form the lateral boundaries of each of these divisions. Thus it will be seen that while the heart is below the superior mediastinum, and in the middle, it is directly between the anterior and posterior mediastina, as they are usually termed. The diagram, Fig. 129, representing a section of the thorax in the median line, shows the relative position of the four subdivisions of the mediastinal space.

Fig. 129.

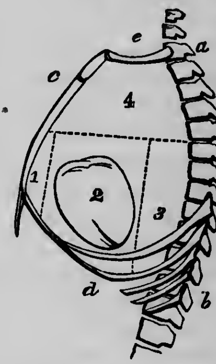


DIAGRAM OF THE THORACIC MEDIASTINA. — *a*, *b*. Dorsal vertebræ. *c*. Sternum. *d*. Diaphragm, or lower orifice of the thorax. *e*. Upper orifice of the thorax. 1. Anterior mediastinum. 2. Middle mediastinum; figure is on the heart. 3. Posterior mediastinum. 4. Superior mediastinum.

The anterior mediastinum has been exposed by the longitudinal section, and removal of the sternum. It contains the lower portion of the remains of the thymus gland, areolar tissue, and some fat. As the diaphragm is deficient behind the xiphoid cartilage, this space is separated from the cavity of the abdomen only by areolar tissue, which accounts for pus sometimes passing from it into that cavity. The cavity of the pericardium can be reached, as in paracentesis pericardii, through this space, without opening either of the pleural cavities.

The PHRENIC NERVES should be noticed before examining the pericardium. They will be found passing through the middle mediastinum, from above downwards on the sides of the pericardium, between it and the pleura. They can usually be distinctly seen without dissecting off the pleura. The left is somewhat longer than the right, on account of the projection of the pericardium to the left side. They descend to the diaphragm, and ramify on its upper surface, between it and the pleuræ; some filaments pass through the muscle, and ramify on its abdo-

minal surface, where an anastomosis is formed between the two nerves. They are said, also, to anastomose with the pneumogastric nerve and solar plexus.

The Pericardium.

The Pericardium is a fibro-serous membrane, which surrounds the heart. To obtain a good view of it, the areolar tissue, and fat in the anterior mediastinum should be removed. It will be found to have a *conical form*, with the base downwards, and the apex upwards. The *base* is closely connected anteriorly, to the cordiform tendon of the diaphragm, from which it cannot, without difficulty, especially in the adult, be separated. In consequence of this attachment, but little motion is allowed to the lower part of the pericardium. The *apex* terminates above by being blended with the thoracic fascia, the external layers of the vena cava, aorta, and pulmonary artery, some distance from the base of the heart. *Laterally* it is in relation with the pleuræ and phrenic nerves. *In front* it corresponds to the sternum, and the cartilages of the fifth, sixth, and seventh ribs, from which it is separated by the anterior mediastinum and the pleuræ, and the left lung, which is excavated for the reception of the heart. *Posteriorly* it forms the anterior wall of the posterior mediastinum.

Its fibrous or external lamina is perforated by all the large vessels which leave or enter the heart. These are the two venæ cavæ, the aorta, the pulmonary artery, and the four pulmonary veins.

The pericardium may now be opened by making a longitudinal, and, if necessary, a transverse incision. The *inner* or *serous layer* presents the same appearance as other serous membranes. It lines the internal surface of the fibrous layer, and is reflected from it upon the large vessels at the base of the heart, and from them over the heart itself.

It is reflected from the fibrous layer to the vessels, where that layer joins their outer coats. This takes place upon the vena cava descendens, near the entrance of the vena azygos. At first it is limited to the anterior surface of this vessel, but nearly surrounds it at the auricle. It is reflected to the aorta at its arch, and to the pulmonary artery at its bifurcation; and, as it descends to the ventricles, it completely invests

those vessels, except where they are in apposition. It covers anteriorly the pulmonary veins between the left auricle and their divisions into branches. The vena cava ascendens is only partly invested by it. Where it is reflected over the vessels, it forms between them depressions or culs-de-sac.

When the heart is empty, it lies loosely in the cavity of the pericardium, but when the former is full, or distended, it just fills the latter. When the blood escapes from the cavities of the heart, or from the great vessels at its base into the pericardium, it destroys life by interfering mechanically with the action of the heart.

The *fibrous layer* of the pericardium is composed of fibres crossing in different directions; a large proportion of them, however, are longitudinal. This membrane is very strong and slightly elastic. Although the heart, when distended, just fills the pericardium, yet the latter is sometimes increased to two or three times the size of the former, by the gradual accumulation of fluid in it.

The student should observe the effect such a collection would have by making pressure upon, or by causing displacement of, surrounding organs. Fat is not unfrequently deposited in considerable quantity between the muscular fibres of the heart and the serous layer which invests it.

The Heart.

It is better that the student should examine the heart before it is removed from the thorax; or, at least, the more important parts of it. Before proceeding to its dissection, he should carefully observe its position in the thoracic cavity, its relations to contiguous parts, its external appearance, and the situation of its different compartments, the auricles and ventricles.

It is situated, as will be seen, in the lower and central part of the thorax, between the lungs, and resting on the diaphragm. Its form is conical, presenting a base, body, and apex. The *base* looks upwards, backwards, and to the right side; it corresponds, *in front*, to an oblique line extending across the sternum from the third intercostal space on the left side to the fourth and fifth on the right side; and *behind*, to the fifth, sixth, and seventh dorsal vertebræ, from which it

is separated by the contents of the posterior mediastinum. The *apex* looks forwards and to the left side; being nearly opposite to the junction of the sixth rib with its cartilage. The *axis* of the heart has a direction from right to left, from above downwards, and from behind forwards.

Before displacing the heart, the following points should be carefully observed:—

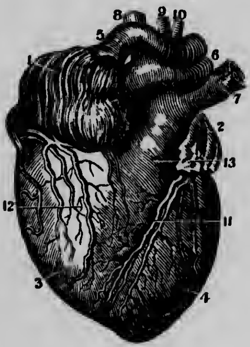
The three great vessels, vena cava descendens, aorta, and pulmonary artery, will be seen at its base. The *vena cava*, Fig. 130 (5), descends on the right side to enter the upper part of the right auricle. The *pulmonary artery*, Fig. 130 (13), prominent at its commencement, ascends from the superior and left portion of the right ventricle. The *aorta*, Fig. 130 (6), at first deep seated and partly concealed by the pulmonary artery, ascends between the other two. The right auricle, Fig. 130 (1), is applied to the aorta, and the left auricle Fig. 130 (2), to the pulmonary artery. Only a small portion of the left auricle can be seen while the heart is *in situ;* the pulmonary artery, the aorta, and a considerable portion of the right auricle being situated in front of it.

A large part of the *right auricle*, Fig. 130 (1), can be seen without disturbing the position of the heart, of which it forms the upper and right portion. It presents anteriorly, and to the right, a smooth shining convex surface, which corresponds mainly to the right lung and to the diaphragm, just above which it is joined by the vena cava ascendens. It is separated, superficially, from the right ventricle by a groove, which is occupied by the anterior coronary artery and vein, and corresponds to the auriculo-ventricular septum.

The *right ventricle*, Fig. 130 (3), forms a large part of the anterior surface of the heart. Its anterior surface, as now seen, is convex, and of a triangular shape; its lower border rests on the diaphragm, while its superior left border is separated from the left ventricle by a groove, Fig. 130 (11), which corresponds to the ventricular septum, and is occupied by the posterior coronary artery and vein; its base, as has been already observed, corresponds to the right auricle and the pulmonary artery. A small portion of the *left ventricle*, Fig. 130 (4), is seen to the left and above the right ventricle. It projects lower down than the right, and thus forms the apex of the heart.

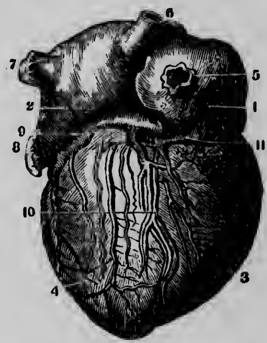
The heart should now be lifted from the pericardium so as to bring into view its remaining surfaces. The inferior surface of the right ventricle, Fig. 131 (3), is flat, triangular and horizontal; it corresponds to the cordiform tendon of the diaphragm. The posterior and left surface of the left ventricle, Fig. 131 (4), is round, and corresponds partly to the diaphragm, and partly to the posterior mediastinum and left lung. The ventricles are separated behind by a groove, Fig. 131 (10), similar to the one noticed in front; it is occupied by the posterior coronary vessels.

Fig. 130.



AN ANTERIOR VIEW OF THE HEART IN A VERTICAL POSITION, WITH ITS VESSELS INJECTED.—1. Right auricle. 2. Left auricle. 3. Right ventricle. 4. Left ventricle. 5. Descending vena cava. 6. Aorta. 7. Left pulmonary artery. 8. The arteria innominata. 9. Left primitive carotid. 10. Left subclavian artery. 11. Anterior cardiac vessels in the vertical groove. 12. Posterior vessels from the transverse groove. 13. Main trunk of the pulmonary artery.

Fig. 131.



A POSTERIOR VIEW OF THE HEART IN A VERTICAL POSITION, WITH ITS VESSELS INJECTED.—1. Right auricle. 2. Left auricle. 3. Right ventricle. 4. Left ventricle. 5. Ascending vena cava. 6. Right posterior pulmonary vein. 7. Left posterior pulmonary vein. 8. End of the left auricle. 9. Great coronary vein. 10. Posterior cardiac vessels in the vertical groove. 11. The same in the transverse groove.

The posterior surface of the auricles, Fig. 131 (1, 2), is convex, and corresponds to the posterior mediastinum; it is divided vertically by a groove, which corresponds to the auricular septum, and is separated from the ventricles by another groove, which corresponds to the auriculo-ventricular septum. The pulmonary veins, Fig. 131 (6, 7), may

be seen coming from the lungs, and entering the left auricle.[1]

Replacing the heart in the pericardium, the student should now proceed to its dissection, commencing with the RIGHT AURICLE. Make an incision from the vena cava descendens down to the vena cava ascendens, and another transversely from this to the left extremity of the auricle. The blood and coagula usually found in this cavity must be removed with a sponge and water.

That portion of the auricle between the mouths of the venæ cavæ is called the *sinus venosus*, while the elongated portion on the left is termed the *auricula*, or *appendix auriculæ;* from the shape of the latter the term *auricle* has been applied to the entire cavity. The right portion of the walls of the sinus seem to be formed by the junction of the venæ cavæ, and is nearly destitute of muscular fibres.

The following are to be observed in the right auricle: The tubercle of Lower, the fossa ovalis, the annulus ovalis, or isthmus of Vieussens, the valve of Eustachius, the mouth of the coronary vein, the valve of Thebesius, the foramina of Thebesius, and the musculi pectinati.

The *tubercle of Lower* is a smooth rounded projection, situated below and a little to the right of the mouth of the descending cava. It is formed by a slight thickening of the wall, and by the oblique manner in which the venæ cavæ join the auricle.

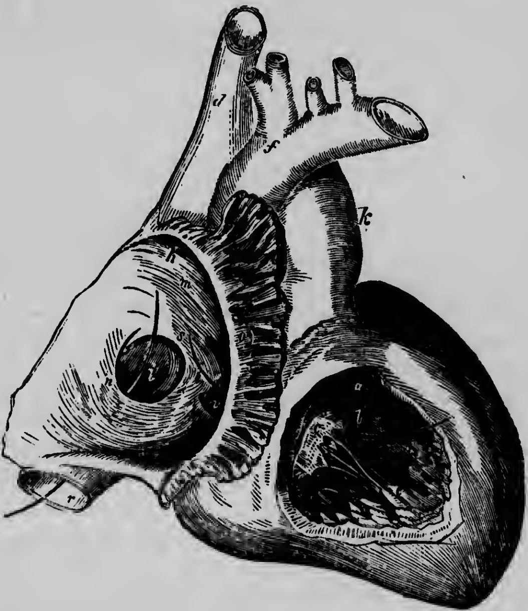
The *fossa ovalis*, Fig. 132, *i*, is a depression situated just above the mouth of the ascending cava and on the auricular septum. It indicates the position of the *foramen ovale* in the fœtal heart, and appears to be formed by a prolongation upwards of the posterior wall of the ascending cava. In the upper part of this fossa a small valvular opening is frequently found in the adult heart, leading into the left auricle; from its oblique direction, probably no intermixture of the blood in the auricles takes place through it.

The *annulus ovalis*, or *isthmus of Vieussens*, Fig. 132, *s*, consists of an elevation around the upper and left margin of the fossa ovalis. In some hearts it is very imperfect.

[1] The vessels of the heart cannot be very satisfactorily traced unless they are injected; and as this cannot well be done in the heart that is intended for dissection, another one will be required for this purpose.

The *valve of Eustachius*, Fig. 132, *n*, is a duplicature of the lining membrane of the auricle, extending upwards from the anterior and inner margin of the mouth of the ascending

Fig. 132.



HEART PLACED WITH ITS ANTERIOR SURFACE UPWARDS, AND ITS APEX TURNED TO THE RIGHT HAND OF THE SPECTATOR. THE RIGHT AURICLE AND RIGHT VENTRICLE ARE BOTH OPENED. PARTS IN RIGHT AURICLE.—*h.* Entrance of vena cava superior, which is itself marked *d.* Inferior cava, marked *r*, has a probe passed through it into the auricle. *m.* The smooth part of the auricle. *o.* Musculi pectinati, seen in the auricular appendix which is cut open. *n.* Eustachian valve placed over the mouth of the inferior cava. *i.* Fossa ovalis, or vestige of the foramen ovale. *s.* Annulus ovalis. The probe leading from *s* into the right ventricle passes through the auriculo-ventricular opening. *v.* Mouth of the coronary vein. PARTS IN THE RIGHT VENTRICLE, in which the other end of the probe, from *s*, appears. *a.* Cavity of conus arteriosus, leading to the mouth of the pulmonary artery *k.* *l.* Convex septum between the ventricles. *c.* Anterior segment of the tricuspid valve connected by slender chords, the chordæ tendineæ, to the musculi papillares *e.* *f.* The aorta.

cava, along the left border of the fossa ovalis. It performs no office in the adult heart, and is often deficient, or scarcely perceptible. In the fœtal heart it serves to direct the blood

from the ascending cava into the left auricle through the foramen ovale.

The *mouth of the coronary vein*, Fig. 132, *v*, is placed a little to the left of the Eustachian valve. It is partly covered by a fold of the lining membrane of the auricle, which is named the *valve of Thebesius*. It prevents the return of the blood into the vein when the auricle contracts; its office, however, cannot be very important, as it is often imperfect or wholly absent.

The *foramina of Thebesius* are small openings, consisting of the mouths of veins, or of mere crypts in the parietes of the auricle. They vary in number and in their location.

The *musculi pectinati*, Fig. 132, *o*, are muscular fasciculi, which extend in parallel lines from the auricula to the auriculo-ventricular orifice. They are named from their resemblance to the teeth of a comb. They are crossed by other fasciculi, which cause a reticulated appearance. This reticulated arrangement is observed especially in the auricular appendix. The inner and outer membranes are in contact with each other between the muscular fasciculi in some portions of the auricle. In examining the structure of the walls of the auricle it will be seen that they are not adapted to exert much force in expelling the blood from the auricle into the ventricle.

The interior of the Right Ventricle should now be examined. For this purpose make two incisions from its apex to its base, along the ventricular septum, and raise the whole of its right and anterior wall without detaching it at the base. To facilitate the study of the parts around the auriculo-ventricular orifice, this flap may be divided through its centre.

The following parts will be found in the dissection of this cavity:—

The *columnæ carneæ* are muscular projections on the inner surface of the ventricle. They present three different kinds of arrangement. The *first* kind are adherent to the walls throughout their whole extent. The *second* are attached to the walls at their extremities, while the middle part of each is surrounded by the lining membrane of the ventricle. They cross each other in different directions, so as to form a reticulated appearance. The *third* set, or *musculi papillares*, are

few in number. They are attached, by one extremity, to the walls of the ventricle, and by the other to the chordæ tendineæ; they have been called the *muscles of the heart.* The fleshy columns give to the internal surface of the ventricle an irregular areolar appearance, and increase the extent of the lining membrane.

The *chordæ tendineæ* are small tendinous cords which extend from the third set of the columnæ carneæ to the tricuspid valve, Fig. 132, *c*; some of them, however, proceed directly from the parietes of the ventricle to the valve. These tendinous chords enter largely into the formation of the valve, which they traverse in different directions; some of them are inserted into the fibrous zone which surrounds the margin of the auriculo-ventricular orifice. They enable the fleshy columns to which they are attached to separate, in the first place, the tricuspid valve from the parietes of the ventricle, and thus allow the blood to get beneath it, and when the valve is forced upwards to close the opening they act as stays by preventing it from being carried into the auricle.

The *tricuspid valve*, Fig. 132, *c*, consists of an annular fold reflected from the margin of the auriculo-ventricular orifice into the ventricle. Its free border is usually divided into three segments, but sometimes into four, or even more. It contains, besides the chordæ tendineæ, some fibrous tissue which projects into it from the margin of the opening into the auricle. Small fleshy masses are sometimes observed attached to its free border. The largest of the three segments is placed between the openings into the auricle and pulmonary artery. This segment may, perhaps, prevent the blood from passing into the pulmonary artery during the filling of the ventricle. The tricuspid valve closes the opening between the auricle and ventricle, when the latter contracts to force the blood into the pulmonary artery.

The *auriculo-ventricular orifice* is situated at the right and posterior part of the base of the ventricle. It is of an elliptical form, and is surrounded by a fibrous band or zone, to which the tricuspid valve and muscular fibres in the parietes of the auricle and ventricle are attached. Its antero-posterior diameter is larger than the transverse.

The *conus arteriosus*, or *infundibulum*, Fig. 132, *a*, is a projection of the ventricle upwards to join the pulmonary artery. It is situated at the anterior and left portion of the base. The

inner surface of the infundibulum is smooth, which facilitates the passage of the blood from the ventricle into the pulmonary artery. The term *locus planus* has been applied to this surface.

The *mouth of the pulmonary artery* is situated at the upper part of the infundibulum, and about three-fourths of an inch from the opening into the auricle, from which it is separated by a muscular elevation. It is about three-fourths of an inch in diameter, is round, and surrounded by a fibrous zone to which are attached muscular fibres of the walls of the ventricle, the middle coat of the artery, and the semilunar valves.

To examine the semilunar valves and the sinuses of Valsalva, the pulmonary artery must be slit up for an inch or more from its commencement.

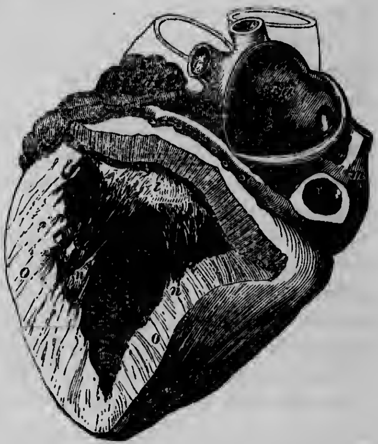
The *semilunar*, or *sigmoid valves*, at the mouth of the pulmonary artery, are similar in appearance and structure to those at the mouth of the aorta, Fig. 134 (1, 2, 3). They are three in number. They consist of folds of the lining membrane of the ventricle and artery, inclosing a fibrous tissue similar to the middle coat of the latter. When they are depressed and made tense, each presents a smooth convex surface towards the ventricle, and a concave surface towards the artery. In the centre of the free border of each valve is a small nodule or sesamoid body, named *corpus Arantii*, Fig. 134, *c*. When the valves are depressed and these small bodies are brought in apposition in the centre, a perfect closure of the mouth of the artery is secured. The semilunar valves, although thin and apparently very delicate, are capable of resisting a great deal of force. They offer no resistance to the passage of the blood from the ventricle into the artery, but effectually prevent its return from the latter into the former.

The *sinuses of Valsalva*, Fig. 134, *s*, *t*, *t*, consist of three small pouches, situated at the commencement of the pulmonary artery, and, also, as will be seen, at the commencement of the aorta. They are formed, by dilatations, in the coats of the artery, between which and the concave surfaces of the valves they are placed. They secure the closure of the valves by allowing the blood to get between them and the walls of the artery. They are more distinct in old than in young persons.

The student should now proceed to the dissection of the left side of the heart, beginning with the auricle. To reach this cavity, the apex of the heart must be drawn forwards and upwards. Make a vertical incision between the mouths of the pulmonary veins on the right and left side, and another from this into the auricula.

The LEFT AURICLE is of a cuboidal form, especially that portion which corresponds to the sinus of the right auricle. It is not quite so large as the right, but has thicker and stronger parietes. The *appendix auriculæ*, Fig. 133, *d*, is longer and more curved than that of the right auricle, but is not so large. Its junction with the *sinus*, or larger portion, is marked by a constricted orifice. The *musculi pectinati* are found only in this part of the auricle, and are less numerous than in the right appendix.

Fig. 133.



HEART SEEN FROM BEHIND, AND HAVING THE LEFT AURICLE AND VENTRICLE OPENED. PARTS IN LEFT AURICLE.—*a*. Smooth wall of auricular septum. *c, c, c*. Openings of the four pulmonary veins. *d*. Left auricular appendage. *e*. Slight depression in the septum, corresponding to the fossa ovalis on the right side. A probe is seen which passes down into the ventricle through the auriculo-ventricular orifice. PARTS IN LEFT VENTRICLE.—*i*. Posterior segment of the mitral valve, behind which is the probe passed from the left auricle. *n, n*. The two groups of musculi papillares. *o*. Section of the thick walls of this ventricle, which may be compared with that of the walls of the right ventricle. *r*. Entrance of inferior cava into right auricle.

The inner surface of the sinus is, for the most part, smooth. The *septum auricularum*, Fig. 133, *a*, presents no depression, or only a very slight one, corresponding to the fossa ovalis. When an opening does exist between the auricles, a small valvular fold may be observed. The *mouths of the pulmonary veins*, Fig. 133, *c, c, c*, will be seen, two on the right, and two on the left side. Sometimes the veins on the same

side open into the auricle by a single orifice. The mouths of the pulmonary veins have no valves. The auriculo-ventricular orifice is situated at the lower and anterior part of the auricle.

To expose the cavity of the LEFT VENTRICLE, make two incisions from the apex to the base, along the septum ventriculorum. In doing this, care should be taken not to injure the parts within the cavity. To obtain a good view of the mitral valves, the flap thus raised may be divided into two by making an incision through its centre.

The general appearance of the interior of the left ventricle is similar to that of the right, and it contains nearly the same number of things to be examined.

The *columnæ carneæ* are not so numerous as in the right, but present the same general arrangement. They are divided into three sets, which are distinguished from each other in the same manner as in the right. Near the mouth of the aorta they are absent, and, consequently, the surface is here smooth. Those which have the chordæ tendineæ attached to them are larger and stronger than the corresponding ones in the right ventricle.

The *chordæ tendineæ* are larger, but fewer in number. They connect the mitral valve to the fleshy columns, and at the same time enter into the structure of this valve, and contribute much to its strength.

The *mitral valve* is situated at the auriculo-ventricular opening. Its structure is similar to that of the tricuspid valve. Its free margin is usually divided into only two segments. The term mitral has been applied to this valve from its fancied resemblance to a bishop's mitre. The right anterior segment is the largest. From its position at the base of the ventricle, it is capable of closing the opening into the aorta, or of assisting in closing the opening into the auricle. The left posterior segment is smaller, and, also, has less mobility.

The *auriculo-ventricular orifice* is smaller than the right. Its transverse diameter is greater than its antero-posterior. It is surrounded by a fibrous zone, which is blended in front and to the right side with the fibrous zone which surrounds the aortic opening. When it is viewed from the ventricle, it appears more like a fissure than an oval opening; this results

from the mitral valve having only two segments. The fibrous band which surrounds this opening furnishes an attachment for the muscular walls of the auricle and ventricle, and for the mitral valve.

The *aortic opening* is round, and a little smaller than the mouth of the pulmonary artery. It is situated at the right anterior part of the base of the ventricle. There is here no infundibular prolongation upwards to join the aorta, as there is in the right ventricle to join the pulmonary artery, hence the mouth of the aorta is nearly on a level with the opening into the auricle. It is surrounded by a *fibrous ring*, which forms a medium of attachment for the middle coat of the aorta, the semilunar valves, and the muscular parietes of the ventricle. This ring, it will be observed, is on one side, common to the aortic and auricular orifices, and forms the only septum between them.

Fig. 134.

Part of the Left Ventricle, and commencement of the Aorta laid open to show the Sigmoid Valves.—*a*. Portion of the aorta. *v*. Muscular wall of the left ventricle. 1, 2, 3. Semilunar or sigmoid valves. *c*, Corpus Arantii in one of them. *e*. Thin lunated marginal portion or lunula. *s*, *t*, *t*. Sinuses of Valsalva. *t*, *t*. Mouths of the two coronary arteries of the heart. *m*. Anterior segment of the mitral valve, the fibrous structure of which is continuous above with the aortic tendinous zone, opposite the attached margin of the sigmoid valve, marked 1. Opposite the valves 2 and 3, the tendinous zone receives below the muscular substance of the ventricle *v*. *h*. Larger chordæ tendinæ. *o*, *o*. Musculi papillares.

The *semilunar* or *sigmoid valves*, and the *sinuses of Valsalva*, Fig. 134, have the same arrangement at the mouth of the aorta, as at the mouth of the pulmonary artery. The valves are thicker and stronger, while the sinuses are somewhat larger and more distinct. The *corpora Arantii* in these valves are particularly well marked. In the sinuses, behind the left and anterior valves, will be found the *orifices* of the *coronary arteries*.

The cavities of the heart are lined by a serous membrane which is continuous with the lining membrane of all the vessels which communicate with these cavities. The different valves of the heart are formed, as has been seen, principally, by duplicatures of this membrane. It is not of equal thickness throughout its whole extent. It is called the *endocardium.*

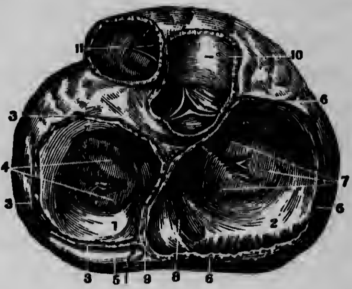
By contrasting the form of the ventricles, and the thickness of their walls, they will be found to be quite different. The right ventricle has a *pyramidal* form, with three well-marked sides; the inferior is flat, the anterior concave, and the left posterior, which corresponds to the septum ventriculorum, is convex. The left ventricle has a *conical* shape, and consequently presents no particular surface. The *base* of each ventricle slopes from before backwards, and from above downwards, making the anterior surface longer than the posterior. It should be observed that the left ventricle is partly received into the right. There is probably little or no difference in the size of the two ventricles, although the capacity of the left seems to be much less than that of the right in the dead subject. This is owing to the flaccid condition of the walls of the right, while those of the left are firm and contracted. Each ventricle will contain about three ounces of blood.

The walls of the left ventricle are about three times as thick as those of the right. The thickness, however, varies in each at different points. In the right the thickness is the greatest at the base, while in the left it is greater in the middle than at the base or apex. The thickness of the septum ventriculorum is about the same as that of the walls of the left ventricle, of which it seems rather to be a part, than of the right. The relative thickness of the walls of the ventricles corresponds to the force which each is required to exert in propelling the blood through the vessels.

The relative position of the four great orifices at the base of the heart should be noticed. To do this the auricles should be detached just above the auriculo-ventricular openings, and the pulmonary artery and aorta just above their mouths. The openings between the auricles and ventricles, Fig. 135 (4, 7), will be found to occupy the posterior part and

sides of the base of the ventricles, while the mouth of the aorta, Fig. 135 (10), is situated between and in front of them; the orifice of the pulmonary artery, Fig. 135 (11), is situated

Fig. 135.



A vertical view of the Auriculo-Ventricular and Arterial Valves, as given by a Section of the Heart at the Ostium Venosum and of the Arteries at their Valves.—1. Depression in the left auricle at the left ostium venosum. 2. Depression in the right auricle at the right ostium venosum. 3, 3. Section of the parietes of the left auricle. 4. Superior or auricular face of the two folds of the mitral valve. 5. Section of the greater coronary vein. 6, 6. Section of the parietes at the base of the right auricle. 7. Auricular face of the three folds of the tricuspid valve. 8. The orifice of the greater coronary vein. 9. Septum of the auricles. 10. A section of the aorta to show its sigmoid valves. 11. The pulmonary artery with its valves.

in front, and a little above and to the left of that of the aorta.

These orifices are surrounded by *fibrous zones* which, taken together, may be regarded as forming the framework of the heart. While they give to each orifice its particular shape, they furnish a fixed attachment for a portion of the muscular parietes of the heart, for the valves, and for the fibrous coats of the aorta and pulmonary artery. The space between the fibrous rings of the auriculo-ventricular openings and the mouth of the aorta, is filled with a dense fibrous substance, which adds greatly to the solidity of this part of the heart. A bone is frequently found in this space, in the hearts of some of the lower animals.

The heart may be regarded as a hollow muscle, divided into two compartments. These are subdivided into the auricular and ventricular, which have no muscular fibres in common. The muscular parietes of the auricles contain fibres which are common to both, and others which belong to each exclusively. The same is true of the ventricles. The muscular structure of the heart seems to differ from that of every other organ in the body. It partakes, more or less, of

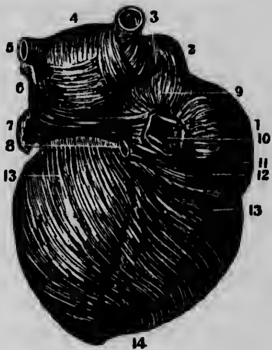
the character of both the striated and non-striated muscles, and yet is different from either of them. It is exceedingly dense and compact, with scarcely any areolar tissue intervening between its fibres or fasciculi. The fibres are variously arranged. Some of them have a parallel direction, while others interlace and intermix with each other. In function, the heart is closely allied to the non-striated or involuntary muscles.

The MUSCULAR FIBRES OF THE AURICLES, Fig. 136, are divided into the proper and common. The *common* have a transverse direction, and are, for the most part, superficial. They are attached to and extend between the fibrous zones of the auriculo-ventricular orifices. They form a very distinct layer on the anterior walls behind the aorta. Some fibres pass into the septum auriculorum. The *proper fibres* have not the same arrangement in the two auricles. In the *left*, they are expanded over the parietes so as to form a smooth even surface. They consist of fasciculi, which have either a circular or oblique direction, and are attached to the fibrous ring of the opening into the ventricle. Fasciculi spread out between the orifices of the right and left pulmonary veins, and also pass between and around those of the same side. Some fibres surround the auriculo-ventricular opening; others pass into the septum auriculorum, while others still mix with the common or superficial fibres. In the auricula, they form a network. In the *right* auricle, the fibres are arranged more distinctly in fasciculi, leaving between them interspaces in which the endocardium and pericardium are separated merely by areolar tissue; they are also limited to a portion of the walls. The direction of the fibres varies, being either oblique or circular. They are attached to the fibrous zone of the auriculo-ventricular opening. In the auricula, they form a reticulated arrangement.

The MUSCULAR FIBRES OF THE VENTRICLES, Fig. 136, like those of the auricles, are divided into the common and proper. The common fibres consist of two portions, the superficial, and the deep-seated or the reflected. The *superficial* fibres are situated on the outside of the proper, and become the *deep-seated*, or *reflected* fibres, after they have penetrated the cavities of the ventricles at their apices. If they be traced, they will

be found to arise from the auriculo-ventricular zones, and to pass downwards, those in front from right to left, and those behind from left to right, to the apex of the heart. As they enter the ventricles, those from behind twist round those from before, so as to form a stellated appearance. Having entered the cavities of the ventricles, they pass upwards on the side opposite to the one upon which they descended; so that the fibres which assist in forming the anterior walls as they descend on the outside, will assist in forming the posterior walls as they ascend on the inside. Some of them terminate by being inserted into the fibrous zones, and others in the columnæ carneæ. As many of the superficial fibres penetrate the ventricles before reaching the apex, loops of different lengths are formed one within another, thus increasing the thickness of the ventricular parietes from the apex towards the base.

Fig. 136.



A Posterior View of the External Muscular Layer of the Heart after the removal of its Serous Coat, &c.—1. Right auricle. 2. Descending vena cava. 3. Right posterior pulmonary vein. 4. Muscular fibres of the left auricle. 5. Left posterior pulmonary vein. 6, 7. The arrangement of the muscular fibres at the end of the left auricle. 8. Orifice of the great coronary vein. 9. Band of fibres between the two venæ cavæ. 10. The orifice of the ascending vena cava; the Eustachian valve is at the end of the line. 11, 12. Muscular fibres at the base of the auricle. 13, 13, 14. Muscular fibres in the ventricles.

The *proper fibres* of the ventricles form two hollow truncated cones, which are covered on the outside by the superficial portion of the common fibres, and on the inside by the reflected portion. There is one cone for each ventricle. Their bases are connected to the fibrous zones around the auriculo-ventricular openings. They are composed of circular, oblique, and spiral fibres.

To unravel the muscular structure of the heart, the student should begin with that of a bullock. This should be prepared by boiling and maceration, until the fibres can be loosened up, and separated from each other. It will require much time and patience to trace out the different fibres and their connections.

The vessels of the heart consist of a right and left coronary artery, and a coronary vein.

The RIGHT CORONARY ARTERY, Fig. 130 (11), arises from the aorta above the anterior semilunar valve. At first, it is concealed by the conus arteriosus, between which and the right auricle, it passes to enter the auriculo-ventricular groove; it winds round in this groove to the posterior part of the heart, where it divides into two branches, one to go along the posterior vertical groove to the apex of the heart, and the other to continue in the auriculo-ventricular groove, until it anastomoses with the left coronary artery. It gives off quite a large branch, which ramifies over the anterior and right portion of the right ventricle.

The LEFT CORONARY ARTERY, Fig. 131 (10, 11), arises near the root of the aorta, above the left semilunar valve. It passes between the conus arteriosus and the left auricle, soon divides into two branches, the largest of which enters the anterior vertical groove, and goes to the apex of the heart; the other and smaller branch enters the auriculo-ventricular groove, and terminates by anastomosing with the corresponding branch of the right coronary. The coronary arteries anastomose freely with each other, not only at the apex and in the horizontal sulcus, but in different parts of the parietes of the heart. They vary in number and in the manner of their distribution.

The CORONARY VEIN, Fig. 131 (9), commences at the apex of the heart, and ascends along the anterior vertical groove to the sulcus between the left auricle and ventricle, in which it continues to the posterior part of the heart, where it opens into the right auricle. In its ascending course, it receives branches from the anterior parietes of the ventricles; as it winds round to the back of the heart, it increases very much in size, as it receives branches from the posterior parietes of the ventricles, and from the left auricle; one of these branches occupies the posterior vertical groove, and is called the *middle* coronary or cardiac vein. Besides the coronary vein and its branches, there are several small anterior cardiac veins, which open into the lower part of the right auricle. The coronary veins have no valves.

The *nerves* which supply the heart consist of two plexuses, the *anterior* and *posterior coronary*. These are derived from

the superficial and deep cardiac plexuses, which will be described in connection with the contents of the superior mediastinum. They accompany the coronary arteries only for a short distance, when they leave them to divide into branches to be distributed to the parietes of the heart. They can be seen for some distance in their course towards the apex of the heart, beneath the serous membrane; they are more distinct in a heart which has been macerated for a few days in alcohol.

The student should now proceed to examine the contents of the POSTERIOR MEDIASTINUM. They are readily exposed by dissecting the pericardium from the diaphragm, and detaching the pleura on each side as it is reflected from the pericardium to the vertebræ and ribs. They consist of the œsophagus, the aorta, the azygos vein, the thoracic duct, and the pneumogastric nerves. The great splanchnic nerves enter this space just before they pass through the diaphragm. These parts should be preserved, to be referred to again in the examination of the contents of the superior mediastinum, in which they are also found.

The *œsophagus* occupies the anterior part of this space, immediately behind the pericardium. It has the *left pneumogastric nerve* adhering to it in front, and the *right* behind. It perforates the diaphragm opposite the ninth dorsal vertebra.

The *aorta*, in passing through this region, has a direction somewhat oblique from the left to the right. It is situated on the left side, and is partly covered by the left pleura. The branches which it gives off, in this part of its course, will be noticed at another time. It enters the abdomen between the crura of the diaphragm, where it rests on the eleventh and twelfth dorsal vertebræ. The *vena azygos* is placed on the right side; it is partly covered by the right pleura. It enters this space from the abdomen through the aortic opening in the diaphragm. The *thoracic duct* lies between the azygos vein and the aorta, and behind the œsophagus. It requires some care to be able to distinguish it from the areolar tissue around it. It passes through the diaphragm with the aorta and vena azygos. The *splanchnic nerves* will be seen on the sides of the bodies of the vertebræ gradually getting more in front of them to perforate the crura of the diaphragm.

The contents of the SUPERIOR MEDIASTINUM are numerous, and their arrangement somewhat complex. The student, in his examination of them, should pursue a systematic course,

so that he may learn the position and relations of each part. His greatest difficulty will be to dissect out some parts, and preserve them, so as to see and learn their relations without destroying other parts. This difficulty may, however, to a considerable extent, be overcome, if he will carefully read a description of what he is to look for before he commences his dissection.

The following are the things to be found and examined in this dissection: The remains of the thymus gland, the vena innominata, the vena transversa, the vena cava descendens, the vena azygos, and several smaller veins, as the superior intercostal, the thyroid, the mediastinal, and the bronchial; the aorta, the arteria innominata, the left common carotid, the left subclavian, the bronchial, and the œsophageal arteries; the pulmonary arteries and veins; the pneumogastric, the phrenic, and the sympathetic nerves; the trachea; the œsophagus; the thoracic duct; and the bronchial glands.

The THYMUS GLAND in the adult subject, exists only in the form of a small quantity of cellulo-adipose substance. In the old subject, very frequently, no trace of it is to be found. In the latter part of fœtal life, and for some time after birth, it exists as quite a large body, reaching from a short distance below the thyroid gland nearly down to the diaphragm. It may become so large, especially in scrofulous children, as to cause death by pressing upon the trachea, or the œsophagus and other parts which are situated beneath it.

The *phrenic nerves* should be sought and traced in the early stage of the dissection; this can be done without disturbing other parts. The *right* nerve enters the thorax between the subclavian vein and artery. As it descends it has on the outer side the vena innominata covered by the pleura, and on the inner side the vena cava descendens and the pericardium. It passes in front of the root of the lung. The *left nerve* descends at first between the pleura and the left carotid artery; it then passes in front of the left portion of the arch of the aorta and the root of the lung to get between the pleura and the pericardium. These nerves are accompanied by small branches of the internal mammary arteries.

The following veins may next be examined:—

The VENA INNOMINATA, Fig. 139 (11), is formed by the junction of the right subclavian and internal jugular, behind the sternal end of the right clavicle; it passes down-

wards about an inch and a half, where it unites with the vena transversa to form the descending cava.

The VENA TRANSVERSA, Fig. 139 (14), commences behind the sternal extremity of the left clavicle, where it is formed by the union of the left subclavian and internal jugular veins; from this point it descends obliquely to the right, about three inches, to join the descending cava. It is usually somewhat larger than the innominata. It lies above the arch of the aorta, and rests on the great arteries which arise from it. It is separated from the sternum by the remains of the thymus gland and by areolar tissue.

There are several small veins which open into the venæ innominata and transversa. The former receives the *right vertebral*, and generally the *right internal mammary* and *inferior thyroid;* the latter has opening into it the corresponding veins on the left side, and also the *thymic*, the *pericardiac*, the *superior phrenic*, and the *superior intercostal*. These veins vary very much in their termination in different subjects.

The VENA CAVA DESCENDENS, Fig. 139 (10), commences opposite the first intercostal space, descends to near the cartilage of the third rib, where it perforates the fibrous lamina of the pericardium, and thence continues down to the right auricle. It has the pleura and phrenic nerve on the right side, the aorta on the left, and the trachea, the right pulmonary artery, and superior pulmonary vein behind. Just before it enters the pericardium it receives the *vena azygos*, which passes up behind the root of the lung, and then bends forwards to terminate in the cava.

The *bronchial veins* terminate, the *right* in the vena azygos, and the *left* in the superior intercostal. To obtain a good view of the vena azygos, the heart and lungs should be removed from the thorax.

The PNEUMOGASTRIC NERVES should now be examined. The *right nerve* enters the thorax between the subclavian vein and artery, crossing the latter nearly at a right angle; it then descends behind the vena innominata and on the side of the trachea to reach the groove between the latter and the œsophagus, in which it continues until it gets behind the root of the right lung. The *left nerve* enters the thorax behind the vena transversa, and between the subclavian and common carotid arte-

ries; it then descends between these arteries to the aorta, which it crosses over and then dips down behind the root of the left lung. Each nerve gives off a *recurrent laryngeal branch;* the right just as it passes over the subclavian artery, and the left as it crosses the aorta. The *left* recurrent branch winds round behind the aorta, and ascends to the larynx in the groove between the trachea and the œsophagus; the *right* passes round the subclavian artery and ascends to the larynx in the corresponding groove on the right side. The recurrent nerves give off *cardiac*, *œsophageal*, *tracheal*, and *pharyngeal* branches. The left is longer than the right, and gives off more cardiac branches.

Each pneumogastric nerve forms two *pulmonary plexuses*, one in front and one behind the root of the lung. The one in front, called the *anterior pulmonary plexus*, is formed by filaments which leave the nerve just above the root of the lung; it also receives filaments from the phrenic and cardiac nerves. The one behind, named the *posterior pulmonary plexus*, consists of a plexiform arrangement of the filaments of the nerve itself; it receives filaments from the anterior plexus, and from the cardiac nerves. The pulmonary plexuses give off filaments which accompany the bronchial tubes, and ramify minutely in the lungs. The pneumogastric nerves, after forming the posterior pulmonary plexuses, join the œsophagus, which they accompany to the stomach. Filaments from each unite round this tube to form the *plexus gulæ.*

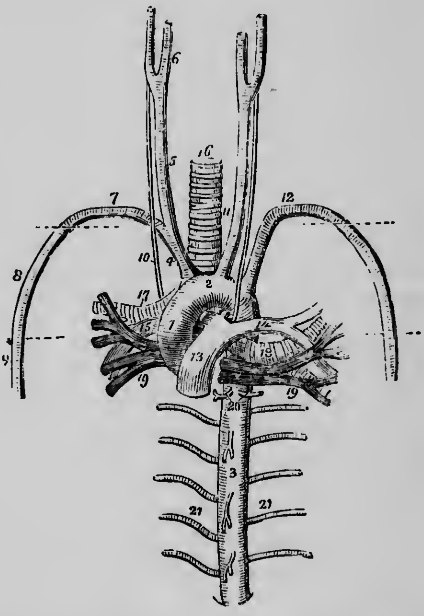
It is somewhat difficult to dissect out the posterior pulmonary plexuses, as their filaments are intermixed with glands and areolar substance. There is an interchange of filaments between the two plexuses which establishes a direct sympathetic connection between the two lungs. The left plexus is considerably larger than the right.

The AORTA commences at the anterior and inner part of the base of the left ventricle, opposite to the junction of the cartilage of the fourth rib and sternum, on the left side. From this point it proceeds upwards, forwards, and to the right side as far as the junction of the cartilage of the second rib with the sternum; it then turns to the left and goes backwards to the body of the second dorsal vertebra, where it curves downwards and somewhat inwards on the side of the vertebræ, to enter the posterior mediastinum.

This part of the aorta is divided into the ascending, trans-

verse, and descending portions, which together form what is denominated the *arch* of the aorta. At its commencement, the *ascending* portion, Fig. 137 (1), lies behind the infundibular process of the right ventricle and the pulmonary artery,

Fig. 137.



THE LARGE VESSELS WHICH PROCEED FROM THE ROOT OF THE HEART, WITH THEIR RELATIONS; THE HEART HAS BEEN REMOVED.—1. The ascending aorta. 2. The arch. 3. The thoracic portion of the descending aorta. 4. The arteria innominata, dividing into, 5, the right carotid, which again divides at 6, into the external and internal carotid; and 7, the right subclavian artery. 8. The axillary artery; its extent is designated by a dotted line. 9. The brachial artery. 10. The right pneumogastric nerve running by the side of the common carotid, in front of the right subclavian artery, and behind the root of. the right lung. 11. The left common carotid, having to its outer side the left pneumogastric nerve, which crosses the arch of the aorta, and as it reaches its lower border is seen to give off the left recurrent nerve. 12. The left subclavian artery becoming axillary and brachial in its course, like the artery of the opposite side. 13. The trunk of the pulmonary artery connected to the concavity of the arch of the aorta by a fibrous cord, the remains of the ductus arteriosus. 14. The left pulmonary artery. 15. The right pulmonary artery. 16. The trachea. 17. The right bronchus. 18. The left bronchus. 19, 19. The pulmonary veins. 17, 15, and 19, on the right side, and 14, 18, and 19, on the left, constitute the roots of the corresponding lungs, and the relative position of these vessels is preserved. 20. Bronchial arteries. 21, 21. Intercostal arteries; the branches from the front of the aorta above and below the number 3 are pericardiac and œsophageal branches.

but as it ascends it gradually approaches the sternum, from which the upper part is separated only by the pericardium, the remains of the thymus gland, and areolar tissue. It has the right auricle and the descending cava on the right side of it; the pulmonary artery, at first in front and then on the left side; and behind, the right pulmonary artery and veins.

The principal part of it is contained in the pericardium, and invested by the serous lamina of that membrane. The *transverse* portion, sometimes called the arch, Fig. 137 (2), lies nearest to the sternum. The vena transversa lies immediately above it, resting on the arteria innominata and the left common carotid and subclavian arteries. The ductus arteriosus and the right pulmonary artery occupy its cardiac aspect, while the trachea is in contact with it behind. The *descending* portion, Fig. 137 (3), has in front of it the left phrenic and pneumogastric nerves, and the root of the left lung. On the left side, and behind, it is in relation with the pleura and the body of the third dorsal vertebra.

The attention of the student should be directed especially to this great vessel, as it furnishes a key to the study of the relations of almost all the other parts found in the superior mediastinum. Besides, a knowledge of it is of the utmost importance, if we wish to understand the nature and the results of aneurisms, which are formed in it.

The ARTERIA INNOMINATA, Fig. 137 (4), arises from the arch of the aorta, near the median line, and extends obliquely upwards to a point behind the right sterno-clavicular articulation. It varies in length from an inch to an inch and a half. It is separated from the sternum by the vena transversa, the sternal muscles and areolar tissue; on the right side, it is in relation with the vena innominata and the pleura; behind, it rests, at first, on the trachea, and then gets to its right side; on the left side, it is separated from the left common carotid artery by a triangular space, in which the trachea is seen. This artery divides into the *right common carotid* and *subclavian.* It sometimes gives off one or two small branches, especially the middle thyroid, or the artery of Neubauer.

The LEFT COMMON CAROTID ARTERY, Fig. 137 (11), arises from the arch of the aorta immediately to the left of the innominata. It passes obliquely upwards to the left, to reach the neck. The vena transversa and the sternal muscles lie in front of it; the trachea and œsophagus are behind it; the pleura partly covers it on the left side.

The LEFT SUBCLAVIAN ARTERY, Fig. 137 (12), arises from the aorta to the left and behind the left common carotid. Its direction is nearly vertical. It is covered on the left side by

the pleura; the pneumogastric and phrenic nerves, the vena innominata, and the sternal muscles are in front of it; the trachea and œsophagus are on the inside of it.

The arteries just described vary a good deal in their origin from the arch of the aorta.

The PULMONARY ARTERY, Fig. 137 (13), is from an inch and a half to two inches in length. It passes upwards, backwards, and somewhat to the left. At first, it is in front of the aorta, and then gets to its left side. Nearly the whole of it is covered by the serous layer of the pericardium. It divides into the right and left pulmonary arteries. At its bifurcation, the remains of the *ductus arteriosus* is found extending from it to a point on the arch of the aorta, nearly opposite to the origin of the left subclavian artery.

The RIGHT PULMONARY ARTERY, Fig. 137 (15), is directed transversely to the root of the right lung. It is about an inch and a half in length. It passes behind the aorta and the vena cava descendens, and in front and a little below the right bronchus. In the root of the lung, it divides into three branches. The serous lamina of the pericardium is reflected upon a portion of this artery.

The LEFT PULMONARY ARTERY, Fig. 137 (14), is quite short. It proceeds to the left lung in front, and a little above the left bronchus, and also in front of the descending portion of the aorta. It divides into two primitive branches.

The PULMONARY VEINS, Fig. 137 (19,19), consist of four principal trunks, two for each lung. These are formed by branches, which originate in the walls of the air-cells of the lungs. One of the right veins is formed by branches proceeding from the lower lobe, while the other is formed by branches from the middle and superior lobes. The *former* has a transverse, and the *latter* an oblique direction towards the left auricle. In the root of the lung on each side, the veins are situated anteriorly, the bronchus posteriorly, and the artery in the middle. From above downwards, on the right side, the bronchus is situated above, the veins below, and the artery in the middle; while, on the left side, the artery is placed above, and the bronchus in the middle.

The TRACHEA, Fig. 138 (7), extends from the fifth cervical vertebra above to the third dorsal below; it commences at

the inferior border of the cricoid cartilage, and terminates by its bifurcation into the two bronchi. It is about five inches in length, and is nearly equally divided in its cervical and thoracic portions. Its diameter is about ten lines in the male, and a little less in the female. Sometimes it increases in diameter from above downwards. Its direction is downwards, backwards, and a little to the right side. In the thorax, it has the œsophagus behind, and one of the pneumogastric nerves on each side of it; the left recurrent nerve and left common carotid artery are on the left and the upper part of the arteria innominata on the right side; the lower part of the last named artery and the arch of the aorta are in front of it.

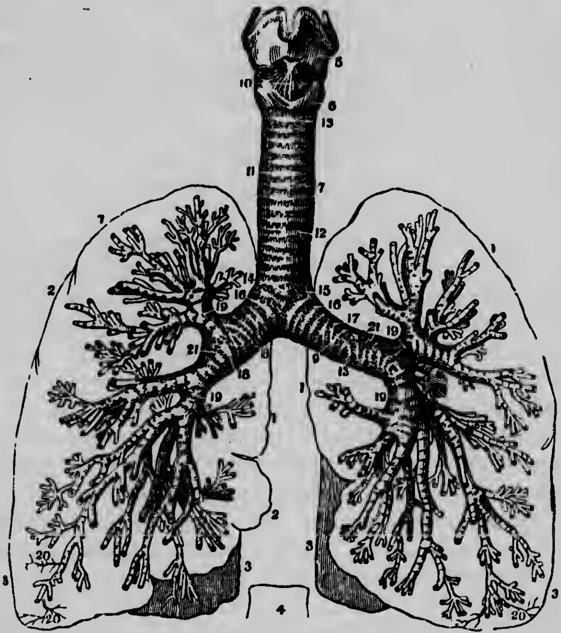
The *bronchi*, Fig. 138 (8, 9), extend from the trachea into the roots of the lungs. The *right* forms nearly a right angle with the trachea; it is about an inch and a quarter in length, and half an inch in diameter. The vena azygos winds around it to enter the descending cava. The *left bronchus* is longer, and has a more oblique direction downwards than the right, to reach the root of the left lung; it also has a smaller caliber. The œsophagus and descending aorta pass behind it. The bronchi at the bifurcation of the trachea are connected together by quite a strong ligament. The triangular space between them is filled with bronchial glands, which usually have a very dark appearance. Filaments from the anterior and posterior pulmonary plexuses accompany the bronchial tubes into the substance of the lungs.

The trachea, together with the bronchi and lungs, may be removed from the thorax, for the purpose of examining their structure. But, before doing this, the *bronchial arteries*, Fig. 137 (20), should be noticed. They arise from the descending aorta, and vary in number; there may be two, three, or four. Sometimes one arises from the internal mammary, or the superior intercostal. They join the bronchi, and accompany them in their subdivisions through the lungs, which they supply with arterial blood, for their nourishment. The *bronchial veins* convey the blood which is transmitted to the lungs by the bronchial arteries into the vena azygos and the superior intercostal vein.

The trachea is composed of imperfect cartilaginous rings, of muscular and fibrous tissue, and of glands and mucous membrane. There are from sixteen to eighteen *cartilaginous*

rings; they form the framework of the tube, keeping it constantly open for the transmission of air to and from the lungs. Each ring embraces about three-fourths of the circumference

Fig. 138.



The Larynx, Trachea and Bronchi, deprived of their Fibrous Covering; also the Outline of the Lungs.—1, 1. Outline of the upper lobes of the lungs. 2. Outline of the middle lobe of the right lung. 3, 3. Outline of the inferior lobes of both lungs. 4. Outline of the 9th dorsal vertebra, showing its relation to the lungs and the vertebral column. 5. Thyroid cartilage. 6. Cricoid cartilage. 7. Trachea. 8. Right bronchus. 9. Left bronchus. 10. Crico-thyroid ligament. 11, 12. Rings of the trachea. 13. First ring of the trachea. 14. Last ring of the trachea, which is corset-shaped. 15, 16. A complete bronchial cartilaginous ring. 17. One which is bifurcated. 18. Double bifurcated bronchial rings. 19, 19. Smaller bronchial rings. 20. Depressions for the course of the large bloodvessels.

of the trachea, leaving one-fourth behind to be filled by muscular fibres. They are more distinct on the inner than on the outer surface. The first ring is usually broader than the others, while the last two are larger. Frequently, two or three of them coalesce in some part of their circumference.

They are strong, elastic, and not easily broken. The last one consists of two segments of smaller circles, united at their inner extremities. Each of these segments is the commencement of one of the bronchi.

The *fibrous tissue* is the yellow elastic kind. It forms a complete tube, which is attached to the cricoid cartilage above, and is lost below in the bronchi. The cartilaginous rings are imbedded in it, and are more thickly covered by it on their external than on their internal surface; hence the difference in the prominence of the rings on the two surfaces. On the inside of the muscular portion of the tube, the elastic tissue forms, apparently, longitudinal folds, which, however, result from the fibres of this tissue being arranged in fasciculi. The use of the elastic tissue in the trachea is very evident. It contributes greatly to its strength, and, by its elasticity, prevents displacement of the organs with which the trachea is connected above and below, when the head is thrown backwards. The trachea may be stretched to the extent of an inch or more, and recover its natural length as soon as the force is removed.

The *muscular fibres* are situated behind, being attached to the ends of the cartilaginous rings. They have a transverse direction, and belong to the non-striated or involuntary class of muscles. They approximate the ends of the cartilages, and thus diminish the size of the tube. They also form a flattening of the trachea behind where it rests upon the œsophagus, which may facilitate the passage of the food to the stomach.

The *mucous membrane* of the trachea is continuous with that of the larynx above, and that of the bronchi below. It is thin and transparent, and adheres closely to the subjacent tissues. It is perforated by numerous small foramina, through which the secretion from the tracheal glands is poured out upon the inner surface of the trachea.

The *tracheal glands* consist of numerous small glandular bodies, situated in the parietes of the trachea. Those found behind, in the membranous part, are the largest. They are placed outside of the muscular layer, between it and the fibrous layer. The others are contained in the fibrous tissue between the rings.

The *bronchi* may be regarded as a continuation of the trachea in two divisions. They have the same elements, with the same arrangement in their structure. The left bronchus

has eight or ten, and the right five or six cartilaginous rings.

The Lungs (Fig. 139) have already been observed *in sitû* in examining the pleuræ. To obtain a good view of their form and external appearance, they should be inflated after their removal from the thorax. If they be not injured in their removal, they will retain the air a sufficient length of time to allow of a satisfactory inspection. Each lung presents three surfaces, a costal, a diaphragmatic, and a mediastinal.

The *costal surface* is convex, and corresponds to the ribs and intercostal spaces, being in apposition with the pleura costalis. This surface presents *two fissures* in the *right* lung, which divides it into *three lobes*, Fig. 139 (21, 22, 23). The principal one commences behind, just below the apex, and extends downwards and forwards to the base near its inner margin; the other, and smaller one, extends from this forward and somewhat downwards to the anterior border of the lung. The first one is much deeper than the last; it reaches entirely to the root of the lung. The *left* lung has but one fissure, which corresponds to the large one in the right; consequently, this lung has but *two lobes*, Fig. 139 (24, 25). The number of lobes, however, is subject to variation in both lungs.

The *diaphragmatic surface* is concave, and sloping from before backwards and downwards, so that the vertical diameter of the lung is considerably greater behind than before. The concavity of the right is deeper than that of the left, on account of the liver pushing the diaphragm higher up on the right side. The margin of this surface presents quite a sharp edge, which projects in between the diaphragm and the costal parietes of the thorax.

The *mediastinal surface* is in contact with the pleura mediastinalis. This surface in each has a concavity for the reception of the heart; the one in the left is the deepest, on account of the heart projecting more on the left than on the right side. The posterior border is round, and nearly straight from the apex to the base of the lung; while the anterior is sharp, oblique, and notched; the left for the apex of the heart, and the right for the right auricle; besides these notches, there is a small one on the right side for the descending cava, and another on the left for the subclavian

artery. The apex of each lung is round, and projects some distance above the first rib; the right more than the left.

The *color* of the lung varies at different periods of life. In the child it is a pale red, while in the adult it is of a grayish blue, interspersed with dark spots, which increase in number as age advances. The posterior part after death usually presents, from hypostatic congestion, quite a dark hue. Lines may be observed on the surface of the lung through the pleura, which indicate the septa between the lobules.

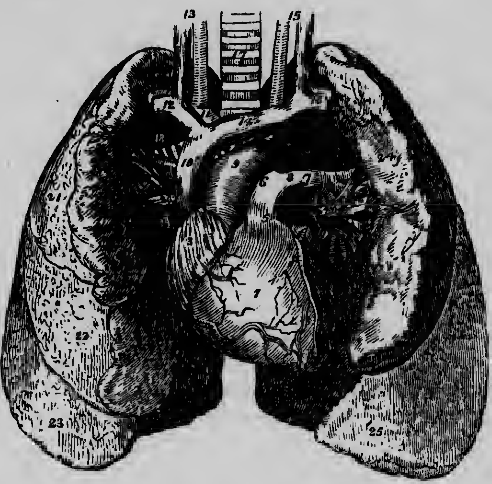
The right lung is somewhat larger than the left. The dimensions of the two lungs are not precisely the same; the vertical diameter of the left lung is the greatest, while the base of the right is rather larger than that of the left. The lungs of the male are usually larger than those of the female. In proportion to their bulk the lungs are very light; this is owing to the air which is never wholly expelled from the cells after it has once entered them. When cut into they have a spongy appearance, and when a portion is compressed between the thumb and fingers the air can be felt escaping from the cells. The resiliency of the lung is well shown in the force with which it expels the air when it has been inflated. This contractile power exists in the yellow fibrous tissue which enters into its structure.

The lung contains in its structure all the elements which are found in its root. They consist of the *ramifications* of the *pulmonary artery* and *veins*, the *bronchial arteries*, *veins*, and the *bronchi*, together with *nerves* and *absorbent vessels*, and the *parenchyma* which holds all the other parts *in situ*. If a bronchus be traced into the substance of the lung, it will be found to divide and subdivide until it ultimately terminates in the air-cells. The *mode of division* observed is dichotomous; that is, the bronchus divides into two tubes, and each of these again divides into two others, and so on until the last division takes place.

The structure of the bronchial ramifications, after the first two or three divisions, undergoes some modification. The *cartilaginous segments*, instead of being arranged on one side of the tube as in the trachea, are distributed on all sides of it, with their extremities overlapping each other. This arrangement continues to the last division, the segments, however, becoming more and more imperfect until they dis-

appear altogether. The *muscular fibres* connect the ends of the cartilages together and form on their inner aspect a

Fig. 139.



ANATOMY OF THE HEART AND LUNGS.—1. The right ventricle; the vessels to the left of the number are the middle coronary artery and veins; and those to its right, the anterior coronary artery and veins. 2. The left ventricle. 3. The right auricle. 4. The left auricle. 5. The pulmonary artery. 6. The right pulmonary artery. 7. The left pulmonary artery. 8. The remains of the ductus arteriosus. 9. The arch of the aorta. 10. The descending vena cava. 11. The arteria innominata, and in front of it the vena innominata. 12. The right subclavian vein, and, behind it, its corresponding artery. 13. The right common carotid artery and vein. 14. The vena transversa. 15. The left carotid artery and vein. 16. The left subclavian vein and artery. 17. The trachea. 18. The right bronchus. 19. The left bronchus. 20, 20. The pulmonary veins; 18, 20, form the root of the right lung; and 7, 19, 20, the root of the left. 21. The superior lobe of the right lung. 22. Its middle lobe. 23. Its inferior lobe. 24. The superior lobe of the left lung. 25. Its inferior lobe.

complete muscular tube. The *mucous membrane* and *fibrous tissue* are prolonged into the lobular tubes, with which the cells communicate directly. The cells are not lined by mucous membrane, but have a thin, delicate, fibrous lamina forming their walls, upon which the capillaries of the pulmonary vessels ramify.

Each lobule is composed of a cluster of air-cells, which communicate with a tube common to them; of pulmonary

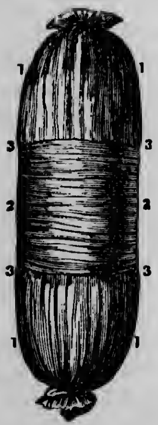
and bronchial vessels, nerves, and absorbents, so that it may be regarded as representing the entire lung.

The *pulmonary artery* accompanies the bronchial ramifications in all their subdivisions, and finally forms a capillary network by anastomosing freely with the radicals of the pulmonary veins in the parietes of the air-cells. The *pulmonary veins*, commencing in the walls of the cells, accompany the bronchial tubes to the root of the lung. The *bronchial vessels*, *nerves*, and *absorbents* are all found ramifying with the air-tubes in the substance of the lung. The nerves are derived from the pneumogastric and sympathetic. The absorbent vessels consist of two sets, the deep and the superficial; they terminate in the bronchial glands.

The Œsophagus has been noticed in the neck, and also in the posterior mediastinum. It is a muscular tube, commencing at the lower orifice of the pharynx and extending to the stomach. It is the smallest section, in diameter, of the alimentary canal, being usually less than an inch. It is narrower above than below, except where it passes through the diaphragm. It is composed of three layers; a mucous, cellular, and muscular. The *mucous* membrane is a continuation of that of the pharynx. It is thrown into longitudinal folds when the œsophagus is empty. The *cellular* layer is intermediate to the other two, and allows of a somewhat loose connection between them. The *muscular* layer, Fig. 140 (1, 1, 2, 2), consists of longitudinal and circular fibres; the latter are internal to the former. The longitudinal fibres arise in part from the posterior aspect of the cricoid cartilage, and terminate in the muscular parietes of the stomach. The circular fibres cease at the cardiac orifice of the stomach. They all belong to the involuntary class of muscles.

In the superior mediastinum, the œsopha-

Fig. 140.



A View of a portion of the Œsophagus of an Adult, seen on its outer side.—1, 1. External or longitudinal muscular fibres. 2, 2. Internal or circular fibres, as shown after the removal of the longitudinal ones. 3, 3. The cut edges of the longitudinal fibres, from which a portion has been removed, so as to show the circular ones.

gus lies in front of the vertebral column, and behind the trachea, being inclined a little to the left side. Its relations to the aorta in passing through the thorax are changed. At first it passes beneath the arch, then to the right of the descending aorta, and finally it gets nearly in front of it. Its course is slightly flexuous.

The course of the aorta has already been observed. It gives off, besides the branches previously described, the œsophageal and intercostal. The *œsophageal branches*, Fig. 137 (3), vary in number and origin. There may be three, four, or more of them. They divide, after reaching the œsophagus, into ascending and deseending branches, which perforate the muscular coat and ramify beneath the mucous membrane.

The *intercostal arteries*, Fig. 137 (21, 21), arising from the aorta, usually consist of nine or ten on each side; the superior intercostal spaces being supplied from the subclavian arteries. They arise from the posterior part of the aorta, and proceed laterally to enter the intercostal spaces. Those on the right side, especially the superior ones, are much longer and more oblique in the first part of their course than the corresponding ones on the left side. As the intercostals enter the intercostal spaees, they give off posterior branches which go back to supply the muscles in the spinal fossæ, and also to send twigs into the spinal canal through the intervertebral foramina. After giving off the posterior branches, they pass forwards along the lower borders of the ribs, occupying the intercostal grooves. Each artery divides into two or more branches, some distance from the sternum, which anastomose with branches from the internal mammary. They are accompanied by the intercostal nerves in the intercostal spaces, and also the veins of the same name.

The THORACIC DUCT, Fig. 141 (12, 13, 14), was seen in the posterior mediastinum, and was also noticed in the dissection of the neck. It commences in the *receptaculum chyli*, which is situated on the second lumbar vertebra, and between the right or long crus of the diaphragm and the aorta. It enters the posterior mediastinum through the aortic opening in the diaphragm, between the aorta and azygos vein, and ascends nearly in a straight direction as far as the third cervical vertebra, having the œsophagus in front of it; it now turns to the left beneath the aorta, and gets to the left side of the

œsophagus and to the inner side of the subclavian artery, and passes up in this direction to the fifth cervical vertebra, where it curves forwards and outwards to join the subclavian vein at its junction with the internal jugular.

In passing through the thorax, it not unfrequently divides into two or three trunks, which again unite into one trunk before its termination; sometimes it terminates in two or three divisions, which have separate openings into the subclavian vein. It is the common trunk of the lymphatics of the whole body, except the right half of the head and neck, and the right upper extremity. The lymphatics of these parts terminate in the *right thoracic duct*, Fig. 141 (15), which opens into the right subclavian at its union with the internal jugular vein.

The Vena Azygos Major, Fig. 141 (10), commences in the abdomen near the second lumbar vertebra, and on the right side. It is formed by the union of branches from several veins, as the superior lumbar, renal, and capsular. Sometimes it communicates directly with the ascending cava. It passes through the aortic opening in the diaphragm, and ascends on the bodies of the vertebræ as far as the fourth dorsal, where it curves forwards over the upper border of the root of the lung to enter the descending cava. It crosses over the intercostal arteries. It receives in the thorax the right intercostal veins, except the upper one or two, the vena azygos minor, the œsophageal, mediastinal and bronchial veins.

The Vena Azygos Minor, Fig. 141 (11), commences in the lumbar region, on the left side, in a similar manner to that of the azygos major on the right side. It passes through the left crus of the diaphragm, usually with the left great splanchnic nerve, and ascends on the left side of the vertebral column, as far as the sixth or seventh dorsal vertebra, where it passes over to the right side to join the vena azygos major; it crosses beneath the aorta and thoracic duct. It receives the inferior six or seven left intercostal veins, also, the œsophageal, phrenic, and mediastinal veins.

The upper five or six intercostal veins, except the first on the left side, unite to form a common trunk, which is sometimes called the *superior vena azygos;* it empties into one of the other azygos veins. The left superior intercostal generally joins the vena transversa. The intercostal veins receive branches through the intervertebral foramina from the

spinal canal, and also from the muscles in the spinal fossæ on the back. By means of the azygos veins, a communication is established between the two venæ cavæ. These veins are not supplied with valves, so that the blood may pass from one cava to the other in either direction.

The SYMPATHETIC NERVE may be seen in the thorax on each side of the vertebral column without any dissection. It consists of twelve ganglia on each side, and branches proceeding from them. The ganglia are situated near the heads of the ribs, and are covered by the pleura and a thin fascia. The first, second, and twelfth, are larger than the intermediate ones. The first is connected to the third cervical ganglion by filaments, which pass round the subclavian artery; sometimes the two ganglia are joined to each other. The twelfth is joined by filaments to the first lumbar.

The ganglia are also connected to each other by filaments. Their branches are external and internal. The *external* connect the ganglia with the intercostal nerves. They consist of two sets of fibres, deep and superficial. They resemble the spinal nerves in their appearance. The *internal* branches are distributed in the mediastinal space, and in the abdomen. Those from the upper five or six ganglia pass in-

Fig. 141.

A VIEW OF THE COURSE AND TERMINATION OF THE THORACIC DUCT.—1. Arch of the aorta. 2. Thoracic aorta. 3. Abdominal aorta. 4. Arteria innominata. 5. Left carotid. 6. Left subclavian. 7. Superior cava. 8. The two venæ innominatæ. 9. The internal jugular and subclavian vein at each side. 10. The vena azygos. 11. The termination of the vena azygos minor in the vena azygos. 12. The receptaculum chyli: several lymphatic trunks are seen opening into it. 13. The thoracic duct dividing, opposite the middle dorsal vertebræ, into two branches, which soon reunite; the course of the duct behind the arch of the aorta and left subclavian artery is shown by a dotted line. 14. The duct making its turn at the root of the neck and receiving several lymphatic trunks previous to terminating in the posterior angle of the junction of the internal jugular and subclavian veins. 15. The termination of the trunk of the lymphatics of the upper extremity.

wards along the intercostal arteries, and are lost principally on the aorta; some filaments go to the bodies of the vertebræ, and to the pulmonary plexus of the same side.

Fig. 142.

A VIEW OF THE GREAT SYMPATHETIC NERVE.—1. The plexus on the carotid artery in the carotid foramen. 2. Sixth nerve (motor externus). 3. First branch of the fifth or ophthalmic nerve. 4. A branch on the septum narium going to the incisive foramen. 5. The recurrent branch, or Vidian nerve divided into the carotid and petrosal branches. 6. Posterior palatine branches. 7. The lingual nerve joined by the chorda tympani. 8. The portio dura of the seventh pair or the facial nerve. 9. The superior cervical ganglion. 10. The middle cervical ganglion. 11. The inferior cervical ganglion. 12. The roots of the great splanchnic nerve arising from the dorsal ganglia. 13. The lesser splanchnic nerve. 14. The renal plexus. 15. The solar plexus. 16. The mesenteric plexus. 17. The lumbar ganglia. 18. The sacral ganglia. 19. The vesical plexus. 20. The rectal plexus. 21. The lumbar plexus (cerebro-spinal). 22. The rectum. 23. The bladder. 24. The pubis. 25. The crest of the ilium. 26. The kidney. 27. The aorta. 28. The diaphragm. 29. The heart. 30. The larynx. 31. The submaxillary gland. 32. The incisor teeth. 33. Nasal septum. 34. Globe of the eye. 35, 36. Cavity of the cranium.

Branches from the sixth or seventh, and the eighth, ninth, and tenth ganglia on each side, pass downwards and forwards on the sides of the vertebræ to the lower part of the posterior mediastinum, where they unite into one cord called the *great splanchnic nerve*, Fig. 142 (12), which perforates the diaphragm to reach the semilunar ganglion, on the side of the cœliac artery. Sometimes it passes through the aortic opening.

The *lesser splanchnic nerve* on each side, Fig. 142 (13), is formed by branches from the eleventh and twelfth ganglia; it passes through the crus of the diaphragm, and joins the solar plexus. A third splanchnic nerve sometimes arises from the twelfth ganglion, enters the abdomen, and goes to the renal plexus.

The *cardiac nerves and ganglion* cannot well be dissected in the thorax, until the student has acquired a knowledge of the contents of the superior mediastinum. For this purpose two subjects will be required; one for the viscera, and another for the nerves. The frequent variation met with in the arrangement of the cardiac nerves renders the study of them more or less unsatisfactory. They are derived principally from three sources, the cervical ganglia, the pneumogastric, and the recurrent nerves. Those from the cervical ganglia are named the *superior*, *middle*, and *inferior cardiac*. These in their course are joined by filaments from the recurrent and pneumogastric. They all terminate in the cardiac plexuses, from which filaments proceed to form the coronary plexuses on the heart.

The *superior cardiac nerve* on each side arises, usually, from the first cervical ganglion, passes down the neck behind the sheath of the carotid artery, and enters the thorax behind the subclavian; sometimes it crosses over the artery. In the thorax, it accompanies the arteria innominata on the right side to its origin, where it divides into two sets of filaments; one set passes in front of the aorta to reach the *superficial cardiac plexus*, while the other passes behind it to join the *deep* or *great cardiac plexus*. In its course in the thorax, it is joined by filaments from the recurrent, and the middle and inferior cardiac nerves.

The *middle cardiac nerve* arises from the middle cervical ganglion, or it may arise from the cord of the sympathetic, descends behind the carotid, and enters the thorax either be-

hind or in front of the subclavian artery. In the thorax, its course is similar to that of the superior cardiac. It also receives filaments from the pneumogastric and recurrent nerves. It is generally the largest of the three cardiac nerves.

The *inferior cardiac nerve* arises from the third cervical ganglion, and passes down behind the arteria innominata and aorta, and terminates in the deep cardiac plexus. It receives branches from the pneumogastric and recurrent.

The *cardiac ganglion* is situated between the arch of the aorta and pulmonary artery, on the right side of the remains of the ductus arteriosus. It receives filaments from the superior cardiac nerves, and also from the pneumogastric. These filaments form the *superficial cardiac plexus*, from which filaments, together with others derived from the deep cardiac plexus, proceed downwards to form a plexus which accompanies the right coronary artery on the heart.

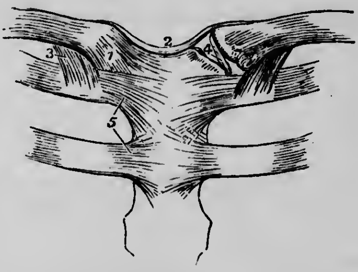
The *deep cardiac plexus* is formed by filaments from the superior cardiac nerves, more from the right than from the left, by the middle and inferior cardiac nerves, and filaments from the pneumogastric and recurrent. It is situated above the pulmonary artery, and between the arch of the aorta and the trachea; a portion of it is also situated between the right pulmonary artery and the bifurcation of the trachea. From this plexus some filaments pass in front of the pulmonary artery, to join others from the superficial plexus. The greater portion of them, however, pass down behind and between this artery and the aorta, to form a plexus, which accompanies the left coronary artery. Some filaments from this plexus also join the pneumogastric nerves, and with them go to the lungs.

Dissection of the Ligaments of the Thorax.

The true ribs are joined to the sternum directly by cartilages, while the false ribs are connected to it indirectly by their cartilages joining those of the true ribs. The sternal extremities of the ribs are excavated, and the cartilages are received into them, while the sternal ends of the cartilages of the true ribs are rounded, and received into concavities on the borders of the sternum. Synovial membranes are found between these cartilages and the sternum, except the first. They are con-

nected to the sternum by ligamentous fibres, Fig. 143 (5), which surround the articulations and spread out on the surfaces of that bone. They add very much to the strength of the bone, which, indeed, is covered on both sides by strong ligamentous bands.

Fig. 143.



THE LIGAMENTS OF THE STERNO-CLAVICULAR AND COSTO-STERNAL ARTICULATIONS.—1. The anterior sterno-clavicular ligament. 2. The interclavicular ligament. 3. The costo-clavicular, or rhomboid ligament, is seen on both sides. 4. The interarticular fibro-cartilage, brought into view by the removal of the anterior and posterior ligaments. 5. The anterior costo-sternal ligaments of the first and second ribs.

It will be convenient to examine, at this time, the ligaments which join the clavicles to the first ribs, to the sternum, and to each other.

The clavicle, on each side, is connected to the first rib by a single ligament, named the COSTO-CLAVICULAR, or the RHOMBOID, Fig. 143 (3). It arises from the lower border of the clavicle, close to the sternum, and is inserted into the cartilage of the first rib. Its direction is inwards and forwards.

The clavicle is joined to the sternum by ligamentous fibres, which wholly surround the joint. They are sometimes designated the ANTERIOR and POSTERIOR STERNO-CLAVICULAR LIGAMENTS, Fig. 143 (1), but there is no distinct line of separation between them. They form a sort of capsular ligament.

This joint is usually divided into two cavities by an INTERARTICULAR FIBRO-CARTILAGE, Fig. 143 (4), and contains two distinct synovial sacs. The fibro-cartilage is attached to the clavicle above, to the sternum below, and to the sterno-clavicular ligaments, anteriorly and posteriorly. It adds considerably to the strength of the joint.

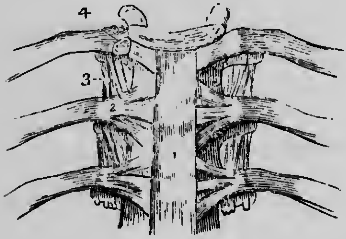
The two clavicles are connected together by an INTERCLAVICULAR LIGAMENT, Fig. 143 (2), which stretches across the sigmoid notch at the upper extremity of the sternum, the depth of which is, by means of it, somewhat diminished.

All the ribs are joined directly to the vertebræ behind. With the exception of the first and the two last, each rib articulates, by its head, with the bodies of two contiguous

vertebræ and their intervertebral substance. The ribs are also joined, by their tubercles, to the transverse processes of the vertebræ.

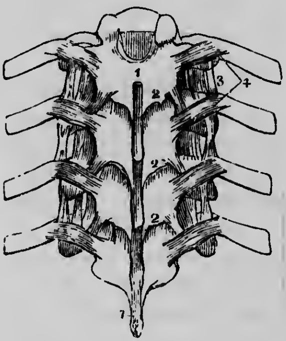
The head of each rib is connected to two bodies of the vertebræ and the intervertebral substance, by an ANTERIOR COSTO-VERTEBRAL, or STELLATE LIGAMENT, Fig. 144 (2), and an INTEROSSEOUS LIGAMENT, Fig. 144 (4). The *first* arises from

Fig. 144.



THE ANTERIOR LIGAMENTS OF THE VERTEBRÆ, AND THE LIGAMENTS OF THE RIBS. —1. The anterior common ligament. 2. The anterior costo-vertebral, or stellate ligament. 3. The anterior costo-transverse ligament. 4. The interosseous ligament connecting the head of the rib to the intervertebral substance, and separating the two synovial membranes of this articulation.

Fig. 145.



A POSTERIOR VIEW OF A PART OF THE THORACIC PORTION OF THE VERTEBRAL COLUMN, SHOWING THE LIGAMENTS CONNECTING THE VERTEBRÆ WITH EACH OTHER, AND THE RIBS WITH THE VERTEBRÆ.—1, 1. The supra-spinous ligament. 2, 2. The ligamenta subflava, connecting the laminæ. 3. The anterior costo-transverse ligament. 4. The posterior costo-transverse ligaments.

the head of the rib in front, and is inserted, by three fasciculi, into the bodies of the vertebræ and the intermediate substance. The *second* arises from the angle between the facets on the head of the rib, and is inserted into the intervertebral substance. The first and the two last ribs have no interosseous ligaments, and, consequently, each one has but a single synovial sac, while each of the others have two.

The ribs are connected to the transverse processes by three ligaments, viz: The anterior, or internal costo-transverse, the posterior, or external costo-transverse, and the middle costo-transverse, or interosseous ligament. A small synovial sac

is found between the tubercles of the ribs and the transverse processes.

The Internal Costo-Transverse Ligament, Fig. 145 (3), arises from the inferior border of the transverse process, passes obliquely downwards, and is inserted into the neck of the rib immediately below. This ligament is absent in the articulation of the first rib.

The External Costo-Transverse Ligament, Fig. 145 (4), extends obliquely from the apex of the transverse process to the tubercle of the rib.

The Middle Costo-Transverse, or Interosseous Ligament, passes from the transverse process directly to the posterior part of the cervix of the rib. Its fibres are usually intermixed with more or less adipose tissue, and cannot be distinctly seen without making a section of the rib.

PART III.

DISSECTION OF ABDOMEN AND LOWER EXTREMITIES.

CHAPTER I.

OF THE ABDOMEN.

Sect. I.—Parietes of the Abdomen.

To dissect the parietes of the abdomen, the subject must be laid on the back, and elevated sufficiently, by means of one or more blocks placed beneath it, to render the muscles tense. The amount of elevation required will depend very much on the fulness of the abdomen, and must be determined by the dissector in each case.

The extent of the integument to be incised in this dissection is indicated by the outlines of the external oblique muscle. If the student should wish to study the superficial fascia and the cutaneous vessels and nerves, it is immaterial how he makes his incisions for the purpose of removing the skin, as his object will be merely to uncover the fascia so as not to injure the vessels and nerves which ramify in it. But if his object be to raise the fascia with the skin, the incisions should be made with reference to the dissection of the external oblique muscle.

As the fibres of this muscle are directed from above downwards and forwards, the integument must be raised so as to admit of exposing the muscle by cutting in the direction of its fibres. If this rule be disregarded, and the student attempts to expose the muscle by cutting across the fibres, his dissection will necessarily be rough and unsatisfactory. Whether the skin be raised separately or with the fascia, it is often convenient to leave the inguinal region untouched for the purpose of making a special dissection of the parts

concerned in inguinal hernia. In this case, the dissection of the skin and fascia may be carried down only to a line extending transversely across from the anterior superior spinous process of the ilium to the linea alba. The student will find the parts in the inguinal region described in the first place simply as forming a portion of the abdominal parietes, and afterwards with special reference to hernia. If he can dissect the lower extremity but once during the session, he had better reserve the inguinal region for a special dissection.

Make an incision from the xiphoid or ensiform cartilage down to the symphysis pubis along the linea alba; and another corresponding to the origin of the external oblique muscle. The last incision will extend laterally from the first over the lower eight ribs, and about three or four inches above the inferior border of the most prominent part of the thorax. If the pectoralis major and serratus anticus muscles have been previously dissected, this incision will not be required; if they have not been, the incision should be made so as to expose those portions of them which are in relation with the external oblique.

Instead of making an incision over the origin of the external oblique, the student may make one, commencing just above the umbilicus, and extending obliquely upwards and outwards, in the direction of the fibres of the external oblique, and then raise the integument in two flaps, one to be reflected upwards, and the other downwards. The advantage of this mode of procedure is that the external oblique is much thicker and its fibres more distinct in the line of this incision than it is in the upper part, where its fibres are short and comparatively few in number, and its aponeurosis is thin and liable to be cut through, thus exposing the rectus abdominis muscle.

When the student has once obtained a distinct view of the fibres or fasciculi of a muscle, in whatever part of it, he can have no difficulty in dissecting it as long as he is careful to follow its fibres. In order to do this, he must take sufficient time to remove the fascia entirely from every fasciculus as he proceeds in the dissection.

The Superficial Fascia of the abdomen is continuous above with the fascia of the thorax, and below with that of the pelvis and lower extremity. In the upper and lateral

parts of the abdomen it is thin, and requires no special notice. Over the linea alba it is thicker and more compact. Around the umbilicus it is dense, and seems to be blended with the tendon underneath. At the lower part of the linea alba it usually contains fibrous fasciculi, which go down to the dorsum of the penis; they constitute the *suspensory ligament* of that organ. It is prolonged round the spermatic cord into the scrotum, where it joins the superficial perineal fascia, and forms separate pouches for the testicles.

In the inguinal region it is divided into a deep and superficial layer. The former is much more dense and compact than the latter; it is adherent to Poupart's ligament, and appears to be continuous with the fascia lata in the upper part of the thigh; a short distance above Poupart's ligament it is blended with the tendon of the external oblique. This lamina has been called the *fascia of Scarpa.* The outer layer of the superficial fascia is areolar, and usually contains adipose substance in this region; hence, it is sometimes called the *adipose layer;* the inner layer is more compact, and contains yellow elastic tissue, which assists the muscles in supporting the abdominal viscera.

The Cutaneous Arteries of the abdomen are derived from the internal mammary, the intercostal, the lumbar, the femoral, and the external iliac. The only one of any importance to be studied is the *arteria ad cutem abdominis.* This arises from the femoral artery a short distance below Poupart's ligament, and passes upwards in the superficial fascia nearly to the umbilicus. It varies in size, but is rarely absent.

The Cutaneous Nerves consist of branches of the lower five or six intercostals and the lumbar. There are two sets of the cutaneous branches of the intercostals, the *lateral* and the *anterior.* The *former* are given off in the intercostal spaces, perforate the muscles, and divide into anterior and posterior filaments; the *latter* are the terminal branches of the intercostals, which, after leaving the intercostal spaces, pass forwards to the sheath of the rectus abdominis, which, together with the muscle, they perforate to reach the integument near the linea alba. The remaining cutaneous nerves are derived from branches of the lumbar plexus, and are distributed in the lower part of the abdomen.

There are five pairs of muscles in the anterior and lateral

parietes of the abdomen. They are the external and internal oblique, the transverse, the recti, and the pyramidal. To render these muscles tense for dissection, besides using blocks, it may sometimes be found convenient to distend the bowels either by inflation or by injecting water into them.

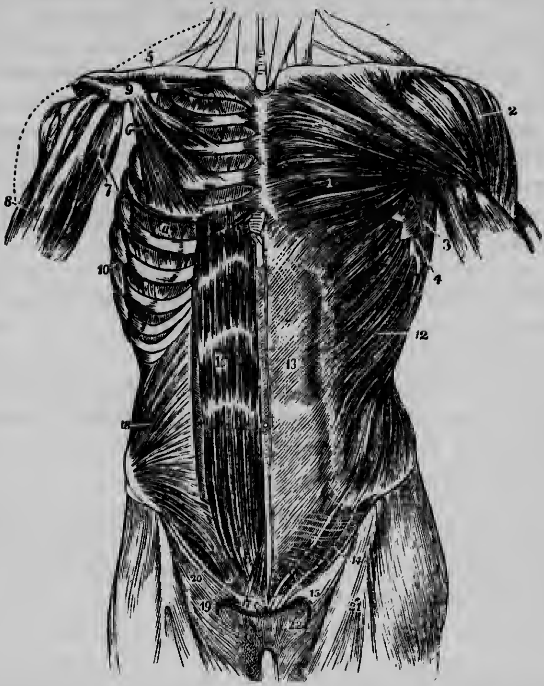
The Obliquus Externus, Fig. 146 (12, 13), lies next to the superficial fascia. It *arises* from the eight inferior ribs near their cartilages, by as many fleshy digitations. These digitations project in between five similar ones belonging to the serratus anticus, and three belonging to the latissimus dorsi. It requires some care in dissecting to make these digitations distinct. A slip extends from the upper part to the pectoralis major. The length and direction of the fibres vary in different parts of the muscle. In the upper part they are short and quite oblique, in the middle they are longer but less oblique, while they are nearly perpendicular in the posterior part.

The *upper* and *middle* fibres terminate in a broad aponeurotic tendon, which is *inserted* into the ensiform cartilage, the linea alba, the pubic bone, and Poupart's ligament; the *posterior* fibres are *inserted* tendinous and fleshy into the anterior two thirds of the crest of the ilium. The student should be careful to observe where the muscular fibres join the tendon, so that he may avoid cutting through it.

Poupart's Ligament, Fig. 146 (14), is regarded by some as the lower border of the tendon of the external oblique folded back upon itself. By others it is considered as consisting of fibres which *arise* from the anterior superior spinous process of the ilium, and extending across the crural region, are *inserted* into the spine and crest of the pubic bone. That portion of it which is inserted into the crest of the pubis is called *Gimbernat's ligament.*

The external oblique muscle is capable of acting in several ways. If the thorax and pelvis be fixed and both muscles act, they will compress the abdominal viscera; if the thorax be fixed, they will approximate the pelvis to it, or if the pelvis be stationary, they will draw the thorax forwards. If one acts separately, it will rotate the thorax to the opposite side, or the pelvis to its own side, or approximate them in a lateral direction. Before dissecting up the external oblique, the following points should be observed:—

Fig. 146.



THE MUSCLES OF THE ANTERIOR ASPECT OF THE TRUNK; ON THE LEFT SIDE THE SUPERFICIAL LAYER IS SEEN, AND ON THE RIGHT THE DEEPER LAYER.—1. The pectoralis major muscle. 2. The deltoid; the interval between these muscles lodges the cephalic vein. 3. The anterior border of the latissimus dorsi. 4. The serrations of the serratus magnus. 5. The subclavius muscle of the right side. 6. The pectoralis minor. 7. The coraco-brachialis muscle. 8. The upper part of the biceps muscle, showing its two heads. 9. The coracoid process of the scapula. 10. The serratus magnus of the right side. 11. The external intercostal muscle of the fifth intercostal space. 12. The external oblique muscle. 13. Its aponeurosis; the median line to the right of this number is the linea alba; the flexuous line to its left is the linea semilunaris; and the transverse lines above and below the number, the lineæ transversæ. 14. Poupart's ligament. 15. The external abdominal ring; the margin above the ring is the superior or internal pillar; the margin below the ring, the inferior or external pillar; the curved intercolumnar fibres are seen proceeding upwards from Poupart's ligament to strengthen the ring. The numbers 14 and 15 are situated upon the fascia lata of the thigh; the opening immediately to the right of 15 is the saphenous opening. 16. The rectus muscle of the right side brought into view by the removal of the anterior segment of its sheath: * the posterior segment of its sheath with the divided edge of the anterior segment. 17. The pyramidalis muscle. 18. The internal oblique muscle. 19. The conjoined tendon of the internal oblique and transversalis descending behind Poupart's ligament to the pectineal line. 20. The arch formed between the lower curved border of the internal oblique muscle and Poupart's ligament; it is beneath this arch that the spermatic cord and hernia pass.

The LINEA ALBA, Fig. 146 (13), is a white line extending from the symphysis pubis to the xiphoid cartilage. It occupies the space between the recti muscles, and is formed by a blending of the tendinous fibres of the broad muscles of the abdomen in the median line. Its breadth increases from below upwards. In pregnancy and dropsies of the abdomen, it sometimes acquires a greatly increased breadth. The *umbilicus* is situated nearly in its centre. This consists of a dense ligamentous substance, to which the integument adheres very closely. It is the remains of the umbilical vein and arteries of the fœtus. When it is necessary to cut into the abdominal cavity, as in the high operation of lithotomy, and in gastrotomy, or to puncture the parietes, as in ascites, it is generally done through the linea alba.

The LINEA SEMILUNARIS, Fig. 146 (13), is a white line situated along the external border of each of the recti muscles. It is caused by the absence of muscular fibres in this portion of the abdominal parietes.

The LINEÆ TRANSVERSÆ, Fig. 146 (13), extend from the linea semilunaris to the linea alba. There are usually four or five of them on each side. They are produced by tendinous intersections in the recti muscles.

The EXTERNAL ABDOMINAL RING, Fig. 146 (15), is an opening in the tendon of the external oblique muscle, situated just above the spine of the pubis. It transmits the spermatic cord in the male, and the round ligament in the female. A fascia is reflected from its margin down over the spermatic cord. This opening and the parts around will be examined in the dissection of the inguinal region with reference to hernia.

The tendon of the external oblique is perforated by numerous small foramina for the transmission of the cutaneous vessels and nerves. The external oblique may be raised by detaching it from the ribs and the crest of the ilium, and also from Poupart's ligament, if it be not desired to preserve the parts in the inguinal region for a special dissection; in the latter case the tendon may be divided by an incision extending from the anterior superior spinous process of the ilium transversely across to the linea alba. It is sometimes convenient, as when the subject cannot well be turned partly on one side, to raise this muscle by making an incision through

it from near the origin of its upper head, obliquely downwards to the anterior superior spinous process of the ilium, nearly in the direction of the fibres of the internal oblique muscle, and then turning one flap forwards, and the other backwards, detach it from the ribs and the crest of the ilium as the dissection proceeds. Whichever mode is adopted, the fascia which separates it from the internal oblique should be dissected up with it.

The OBLIQUUS INTERNUS, Fig. 146 (18), has an extensive origin and a more extensive insertion. It *arises* from the fascia lumborum, the crest of the ilium, and the external two-thirds of Poupart's ligament. Its fibres diverge so as to be *inserted* into the lower five or six ribs, the xiphoid cartilage, the linea alba, the symphysis pubis, the body of the pubic bone, and the linea pectinea. The *posterior* fibres ascend obliquely to the ribs, and the upper part of the linea alba; the *middle* have a transverse direction, while the *anterior* pass forwards and downwards, some to the lower part of the linea alba, others to the body of the pubis and the linea pectinea. It will be observed that while all the lower and anterior part of the external oblique, to the outer side of the rectus muscle, is aponeurotic, the corresponding portion of the internal oblique is muscular, and that in the upper and anterior part the reverse is true.

The tendon of the internal oblique, above a point midway between the umbilicus and symphysis pubis, divides into two layers, the *anterior* of which passes in front of the rectus, and unites with the tendon of the external oblique about three-fourths of an inch outside of the linea alba, while the *posterior* layer passes behind the rectus and joins the tendon of the transversalis muscle. The anterior layer extends higher up in front of the rectus than the posterior does behind it. The *lower part* of the tendon does not split, but the whole of it passes in front of the rectus. The lowest portion of the tendon unites with the corresponding portion of the tendon of the transversalis, to form the *conjoined tendon*, Fig. 146 (19), of these two muscles. That part of the conjoined tendon which is inserted into the linea pectinea is placed directly behind the external abdominal ring, and, as will be seen in the dissection of the inguinal region, forms an important part in the anatomy of direct inguinal hernia.

As no fibres arise from the inner third of Poupart's ligament, there is left a *space*, Fig. 147 (11), between it and the lower border of the muscle for the passage of the spermatic cord.

The action of the internal oblique muscle is similar in some respects to that of the external oblique. When both act at the same time, they will compress the abdominal viscera, or approximate the thorax and pelvis. When one acts alone, or in conjunction with the external oblique of the opposite side, it will rotate either the thorax or the pelvis to its own side; or if it acts with the external oblique of the same side, it will bend the thorax to that side, or draw the pelvis up.

The CREMASTER MUSCLE, which *arises* from Poupart's ligament, in common with the lower fibres of the internal oblique, is found in the outer and anterior part of the space just named. This muscle accompanies the spermatic cord through the external abdominal ring, and down into the scrotum, where it forms *loops* on the tunica vaginalis; its fibres then ascend on the cord, and are *inserted* into the linea pectinea. Some of its fibres are usually lost on the tunica vaginalis.

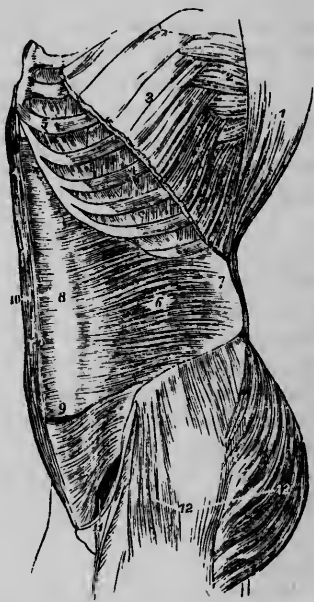
The fibres of the cremaster are frequently very pale and few in number, so that some care is required to separate them from the cord. Its use is to draw up and support the testicle.

In raising the internal oblique muscle, the student will sometimes experience some difficulty in finding the separation between it and the transversalis muscle. This may be done most readily by dividing its fibres near the anterior portion of the crest of the ilium, where the two muscles are separated by the *internal circumflex ilii artery*. When the separation is once found, it is comparatively easy to follow it, especially in the upper and posterior part, where the direction of the fibres is different. The lower part of the muscle is closely connected to the transversalis, and it requires some care to separate them.

The TRANSVERSALIS, Fig. 147 (6, 7, 8, 9), *arises* from the fascia lumborum, the crest of the ilium, the external half of Poupart's ligament, and the lower six or seven ribs, where it indigitates with the diaphragm. All its fibres, with the exception of the lower, or those which arise from Poupart's

ligament, have a transverse direction, and are *inserted* into the linea alba. The *lower* fibres pass forwards and down-

Fig. 147.



A Lateral View of the Trunk of the Body, showing its Muscles, and particularly the Transversalis Abdominis.—1. The costal origin of the latissimus dorsi muscle. 2. The serratus magnus. 3. The upper part of the external oblique muscle, divided in the direction best calculated to show the muscles beneath, without interfering with its indigitations with the serratus magnus. 4. Two of the external intercostal muscles. 5. Two of the internal intercostals. 6. The transversalis muscle. 7. Its posterior aponeurosis. 8. Its anterior aponeurosis, forming the most posterior layer of the sheath of the rectus. 9. The lower part of the left rectus, with the aponeurosis of the transversalis passing in front. 10. The right rectus muscle. 11. The arched opening left between the lower border of the transversalis muscle and Poupart's ligament, through which the spermatic cord and hernia pass. 12. The glutæus maximus, and medius, and tensor vaginæ femoris muscles invested by fascia lata.

wards, and are *inserted* into the lower part of the linea alba, the body of the pubis and the linea pectinea, forming with the internal oblique, the *conjoined tendon of the internal oblique and transversalis.* The tendon of this muscle is applied to the posterior surface of that of the internal oblique, with which it passes both behind and in front of the rectus. The upper and anterior part of the transversalis is muscular, where the corresponding part of the internal oblique is tendinous. Its principal use is that of a compressor of the viscera of the abdomen.

The *fascia lumborum* is described in connection with the muscles of the back, and should be studied when they are dissected. The internal oblique and transversalis muscles are sometimes described as arising directly from the vertebræ;

the former from the spinous, and the latter from the transverse processes of the lumbar vertebræ.

To expose the rectus, make an incision through the tendon of the external oblique and the anterior lamina of the internal oblique, from the cartilage of the sixth rib to the pubis, about three-fourths of an inch from the linea alba, and parallel with it; then dissect these tendons up from the muscle, turning one flap inwards and the other outwards. At the lower part of the rectus the incision will extend through the tendons of the three broad muscles, as they all pass in front of that muscle. They are easily separated from the muscle, except at the linæ transversæ, where they are blended with the tendinous intersections, from which it will require some care to detach them. After exposing the muscle in this way, divide it opposite the umbilicus, and reflect one portion upwards and the other downwards, when its relations to the tendons of the broad muscles may be examined; *branches* of the *epigastric* and *internal mammary arteries*, and of the *intercostal nerves*, will be seen penetrating it from behind. The termination below of the posterior lamina of the tendon of the internal oblique, and the tendon of the transversalis, will be observed. They generally present quite a distinct semilunated border, but not always. The tendinous intersections are very imperfect behind, and do not usually adhere to the sheath of the rectus.

The Rectus, Fig. 146 (16), *arises* from the upper border of the os pubis, between the spine and symphysis, by a flat tendon. It passes upwards on the side of the linea alba, gradually increasing in breadth but diminishing in thickness, until it reaches the thorax. It is *inserted* into the cartilages of the fifth, sixth, and seventh ribs, and sometimes into the xiphoid or ensiform cartilage.

The fibres are interrupted in their course by the *lineæ transversæ;* one of which is placed opposite to the ensiform cartilage, one between this and the umbilicus, one at the umbilicus, and another lower down. Each presents a zigzag line, and only two of them, the one at the ensiform cartilage and the one at the umbilicus, extend entirely across the muscle. The rectus draws the thorax towards the pelvis or the pelvis towards the thorax; it also acts as a compressor. The tendinous intersections connect it with the tendons of

the broad muscles, and also, when it contracts, prevent its bulging so much as it would if its fibres extended the whole length of the muscle; they may, perhaps, augment somewhat its power to act.

The PYRAMIDALIS, Fig. 146 (17), *arises* from the upper surface of the body of the pubic bone, anterior to the rectus. It passes upwards, and is *inserted* into the linea alba two or three inches above the symphysis pubis. It is of a triangular shape, and usually placed in a sheath, formed by a splitting of the conjoined tendon of the internal oblique and transversalis. It is sometimes absent. The pyramidalis acts on the linea alba in a vertical direction.

ANATOMY OF INGUINAL HERNIA.

The anatomy of the inguinal region may now be examined with reference to hernia. Most of the parts contained in it have already been noticed, without, however, any particular regard to their relations to protrusion of the bowel. They will now be described as they appear in the process of dissection.

The INGUINAL REGION is the triangular space bounded *above* by a line extending from the anterior superior spinous process of the ilium to the linea alba, *below* by Poupart's ligament and the upper border of the body of the pubic bone, and *internally* by the linea alba.

Dissect the skin from the superficial fascia, and reflect it downwards. This dissection should be carried to a short distance below Poupart's ligament and down to the dorsum of the penis. The superficial fascia contains the *arteria ad cutem abdominis*, and *one* or *two small branches* from the superior external pudic; also *three* or *four lymphatic glands*, which are usually imbedded in it along Poupart's ligament. Near the linea alba, the fibres which descend in the fascia to form the *suspensory ligament* of the penis, Fig. 148 (2), should be observed. The adipose layer is placed next to the skin, Fig. 148 (1, 1), and presents an uneven areolar appearance. There is generally considerable fat in this region, especially towards the pubis. The membranous layer lies next to the tendon of the external oblique. Its under surface has

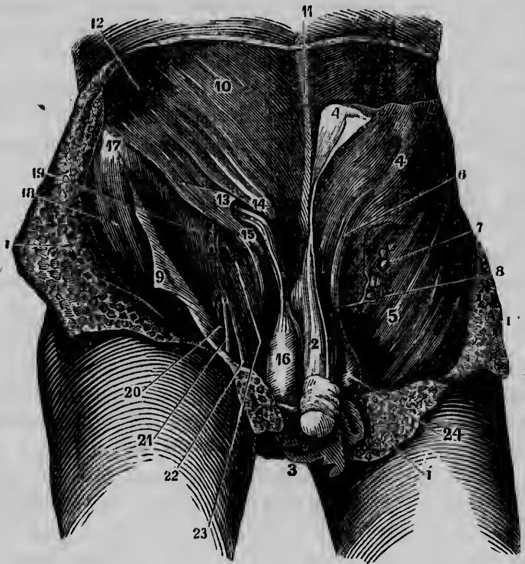
a smooth even appearance. This layer, Fig. 148 (4, 4), alone is sometimes spoken of as constituting the *superficial fascia.* The fascia is next to be dissected and reflected downwards in the same manner, and to the same extent, as the skin. To preserve the *intercolumnar* or *spermatic fascia,* which is reflected from the margin of the external abdominal ring down over the spermatic cord, it is better to raise the superficial fascia from the ring and cord by insinuating the handle of the scalpel or the finger under it, and separating it from the parts beneath. Poupart's ligament, from its origin to its insertion into the spine of the pubis, should be carefully cleaned, so as to be brought distinctly into view, and the cord should be raised for a short distance below the ring, so that it may be made more or less tense, and thus show more clearly how the intercolumnar fascia is connected to the ring.

To raise the tendon of the external oblique, make an incision from the anterior superior spinous process of the ilium transversely to within about an inch and a half of the linea alba, and another from this to the pubis on the inner side of the ring; then dissect it from the internal oblique and the cord. The first incision should not be carried beyond the junction of the two oblique muscles, as it is only the tendon of the external oblique that is to be turned down. If the handle of the scalpel be carried along the cord through the ring, the intercolumnar fascia will be seen coming from the edges of the ring to surround the cord. Fibres will also be observed extending transversely over the cord as it passes through the ring, and for a short distance below it; these are sometimes called the *intercolumnar bands* or *fibres,* Fig. 146 (15). Detach the intercolumnar fascia from the margin of the ring, and observe the manner in which it is formed.

The External Ring, Fig. 148 (13), consists of a slit in the tendon of the external oblique, commencing from an inch to two inches above, and external to the pubis; the fibres diverge as they pass downwards and inwards to be inserted, the *lower external* into the spine of the pubis with Poupart's ligament, and the *upper internal* into the symphysis and the pubic bone on the opposite side. The term *columns* or *pillars,* Fig. 148 (14, 15), has been applied to these fibres. The fibres of the internal column cross those of the

corresponding one on the opposite side. The opening thus formed is of a triangular shape, with the base towards the

Fig. 148.



A View of the External Parts concerned in Inguinal and Femoral Hernia.—1, 1. The common integument and adipose tissue of the abdomen turned back. 2. The penis, with its suspensory ligament deprived of the integument. 3. Integument of the scrotum drawn down. 4, 4. Fascia superficialis of the abdomen. 5. The same on the thigh. 6. The left spermatic cord covered by the fascia superficialis. 7. The inguinal glands which are imbedded in the fascia superficialis. 8. Branch of the external pudic artery. 9. Fascia superficialis turned off the thigh. 10. Tendon of the external oblique. 11. Linea alba. 12. External oblique muscle. 13. External abdominal ring. 14. Its superior column. 15. Its inferior column. 16. Testicle covered by the cremaster muscle. 17. Anterior superior spinous process of ilium. 18. Close attachment of the fascia superficialis on the outside of the thigh. 19. Cribriform openings in the fascia lata femoris. 20. Saphenous opening. 21. Branch of the saphenous vein. 22. Saphenous vein. 23. External femoral ring. 24. Testicle.

pubis. Its size varies very much in different subjects. In the female it is usually much smaller than in the male. The intercolumnar fibres, which arise generally from Poupart's ligament, and extend upwards and inwards across the upper part of the triangular opening, convert it into one of a

quadrangular shape, also diminish its size, and bind together its columns. There are *other fibres* beneath these, which extend simply between the columns.

In cases of hernia, these fibres are stretched so as to allow the columns to be separated further than is natural from each other. If the hernia be one of long standing, they are usually found considerably increased in size.

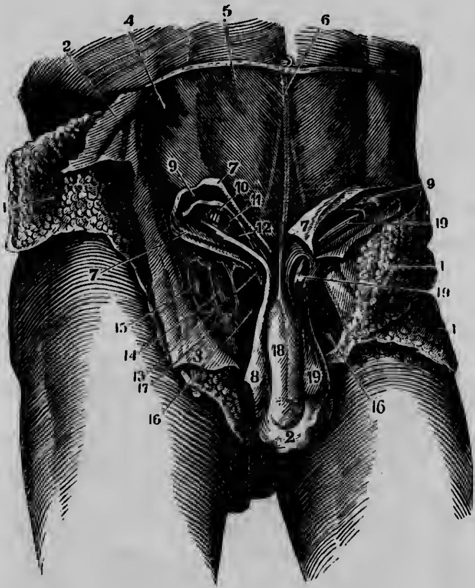
The *boundaries* of the ring, as will now be seen, are the columns, one on each side, the body of the pubic bone between the insertion of the columns below, and the intercolumnar fibres above.

Beneath the internal column is found a set of fibres which arise from the linea pectinea, anterior to the insertion of the conjoined tendon of the internal oblique and transversalis, and pass upwards and inwards to be inserted into the linea alba. They form the *triangular ligament.* Turn down the tendon of the external oblique, and make it more or less tense with hooks, then carefully remove the areolar tissue from the internal oblique and cremaster muscles. The lower fibres of the internal oblique are frequently somewhat irregular in their position and direction, but a little care will suffice to trace them distinctly and loosen them up from the cord or separate them from the cremaster. The cord is next to be separated from its connections in the inguinal canal, and raised up with the tenaculum. The most difficult part of this dissection is to preserve the fascia transversalis in the posterior wall of the canal, and especially where it is reflected from the internal ring over the cord. The position of the cord and the walls of the canal should now be carefully examined.

The Inguinal Canal, Fig. 150 (3, 3), is about an inch and a half in length. It extends from the internal to the external ring. Its direction is oblique, from above downwards, from without inwards, and from behind forwards. Its boundaries are, *in front*, the tendon of the *external oblique*, with a portion of the internal oblique; below, by *Poupart's ligament; behind*, by the *fascia transversalis* externally, and the *conjoined tendon* of the internal oblique and transversalis internally; *above*, its boundary is more indefinite; it corresponds to the space between the tendon of the external oblique and the fascia transversalis, which includes the *lower borders* of the *internal oblique* and *transversalis muscles.*

The internal oblique and transversalis muscles should now be detached from Poupart's ligament, and reflected upwards

Fig. 149.



A View of the Deep-seated Parts concerned in Inguinal and Femoral Hernia.—1, 1. Integument and adipose tissue. 2. Integument of the scrotum. 3. Fascia superficialis abdominis and fascia lata femoris turned off. 4. External oblique muscle. 5. Its tendon. 6. Linea alba. 7. Lower part of the external oblique tendon divided and turned back. 8. Right testicle in the tunica vaginalis testis. 9. Internal oblique and transversalis muscles. 10. Epigastric artery and vein, as placed between the fascia transversalis and the peritoneum. 11. Points to the surface of the peritoneum through the internal ring. 12. Cord covered by the cremaster muscle lying in the inguinal canal. 13. External ring laid open. 14, 15. Infundibuliform fascia of the vessels laid open so as to expose them. 16. Pectineus muscle. 17. The vessels in their sheath. 18. Penis and ligamentum suspensorium. 19, 19. Testicle and cord in its entire length.

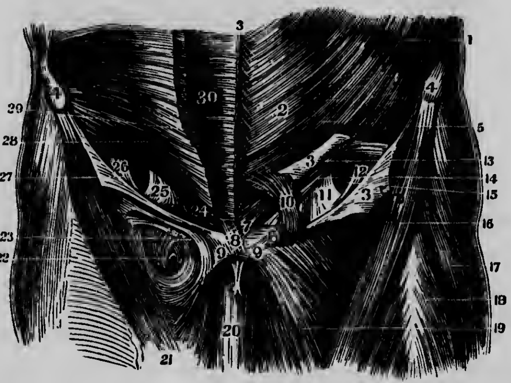
from the fascia transversalis. By making these muscles tense, a good idea may be obtained of the extent and manner in which they enter into the formation of the posterior wall of the inguinal canal. As the tendon of the transversalis curves downwards, it expands, so as to be inserted into the linea pectinea, and for some distance into Poupart's liga-

ment; thus it occupies a large portion of the space on the inner side of the internal ring.

The Fascia Transversalis, Fig. 150 (11, 12, and 25, 26), is thicker and more dense in the inguinal region than in any other part of it. It adheres to Poupart's ligament throughout its whole extent; but in front of the femoral vessels the fascia is continued an inch or more into the thigh, as will be seen in the dissection of the anatomy of crural hernia, and in front of the iliacus internus and psoas magnus muscles joins the iliac fascia. Internally it lies beneath the conjoined tendon and the rectus, being closely connected to the tendon of the transversalis.

The Internal Ring, Fig. 150 (15), is situated about half

Fig. 150.



A View of the Abdominal Muscles and the Abdominal, or Inguinal Canal. —1. External oblique muscle of the abdomen. 2. Its aponeurosis. 3. Its tendon slit up and turned back to show the canal. 4, 4. Anterior superior spinous processes. 5. Upper portion of Poupart's ligament. 6. External column of the external ring. 7. Internal column of the external ring. 8. Intercrossing of the tendons of the two sides. 9, 9. Bodies of the pubes. 10. Upper boundary of the external ring —the line points to the ring. 11, 12. Fascia transversalis. 13. Fibres of the internal oblique turned up. 14. Fibres of the transversalis muscle. 15. Points to the internal ring—the opening is enlarged for the demonstration. 16. Sartorius. 17. Fascia lata femoris. 18. Rectus femoris. 19. Adductor longus. 20. Penis. 21. Fascia lata of the right thigh. 22. Point where the saphenous vein enters the femoral. 23. Fascia lata as applied to the vessels. 24. Insertion of the transversalis muscle on the pubis. 25, 26. Correspond to 11, 12, of the opposite side, and indicate the fascia transversalis. 27. Poupart's ligament, turned off from the internal muscles. 28. Transversalis abdominis. 29. Internal oblique. 30. Rectus abdominis.

way between the anterior superior spinous process of the ilium and the symphysis pubis, and half an inch above Poupart's ligament. It is overlapped by the internal oblique, and hence cannot be observed until this muscle is raised. To examine this opening, cut through the fascia transversalis a short distance above it, and separate the fascia from the peritoneum down to where the cord enters the ring, then by carrying the handle of the scalpel along the cord, the continuation of the fascia over it, and through the canal, is rendered distinct; showing that, while there is no opening through the fascia from without, there is one from within through which the bowel can escape from the cavity of the abdomen.

The internal ring then is an opening which leads into a pouch formed by the testicle carrying before it the fascia transversalis in its descent into the scrotum. Sometimes the internal ring presents a well defined margin on one side, or entirely around it. At other times, it is difficult to demonstrate, satisfactorily, the reflection of the transversalis fascia over the cord. When the cord is made tense, the fascia transversalis, as it is reflected from the internal ring, presents a funnel-shaped appearance, and hence the name of *infundibuliform fascia* has been given to this part of it.

The EPIGASTRIC ARTERY, Fig. 149 (10), and Fig. 151 (13), with its accompanying veins, will be found by dividing the transversalis fascia on the inner side of the internal ring. It lies between the fascia and peritoneum, and crosses the canal nearly at right angles. Its distance from the internal ring varies from one-fourth to one-half of an inch.

When the internal surface of the inguinal portion of the parietes of the abdomen is examined, *two pouches* or *fossæ* are observed corresponding to the two rings. These are formed by the remains of the hypogastric artery, which, in its course from the internal iliac to the umbilicus, projects here into the cavity of the abdomen. The peritoneum is reflected over it. Sometimes the hypogastric artery is situated a short distance to the inner side of the epigastric, when an additional small pouch is formed. These fossæ cause a greater or less predisposition to rupture, according to their depth, by directing the bowel against either the internal or external ring.

The student should now review the parts, the dissection of which he has just completed, with reference to hernia. There

are two forms of inguinal hernia—*direct*, or *ventro-inguinal*, and *indirect*, or *oblique*. In the oblique form, the bowel traverses the entire length of the canal passing through both rings; in the direct, it escapes directly through the external ring, and does not pass through the canal.

In Oblique Hernia, the course of the bowel and the different coverings which it obtains in its descent, are as follows: Its course is similar to that of the spermatic cord. As the internal oblique overlaps the internal ring, it offers resistance to the entrance of the bowel into the canal, hence the bowel is forced downwards beneath the lower border of the muscle; in the canal, it is directed downwards, inwards, and somewhat forwards; when it leaves the external ring, its direction is towards the scrotum, along the course of the cord. The coverings which it gets are, *first*, the *peritoneum* at the internal ring; this constitutes the *sac; second*, the *transversalis*, or *infundibuliform fascia*, as it enters the canal; *third*, the *cremaster muscle*, while passing through the canal; *fourth*, the *intercolumnar*, or *spermatic fascia*, as it goes through the external ring; *fifth* and *sixth*, the *superficial fascia*, and the *integument;* the last two coverings it receives entirely outside of the canal.

The cremaster is usually found in front, and on the outside of the tumor; while the cord is generally situated behind, and on the inner side. The bowel almost necessarily gets between the cord and the cremaster, from their relative position in the upper part of the canal.

In Direct Hernia, the coverings are the same as in indirect, with a single exception; the *conjoined tendon* of the internal oblique and transversalis takes the place of the cremaster muscle. Sometimes the conjoined tendon is torn, or its fibres are separated so as to allow the bowel to pass through it; when this happens, it will not constitute one of the coverings.

Another form of direct hernia is sometimes described, in which the bowel enters the canal between the epigastric artery and the outer border of the conjoined tendon.

When the bowel passes through the internal ring, but is retained in the canal, it is called *bubonocele*, or *concealed inguinal hernia*. In this case, the tendon of the external oblique will form one of the coverings.

The *epigastric artery* is the principal one to be avoided in dividing a stricture in either form of inguinal hernia. This is to be done by cutting upwards and parallel to the artery.

The *seat of stricture* in *indirect hernia* may be at the internal ring, or where the cord passes under the internal oblique muscle, or at the external ring. It occurs most frequently at the internal ring, and, next to this, where the cord passes beneath the muscle. In *direct hernia*, the stricture may occur at the external ring, or at the conjoined tendon, especially if the tendon be perforated by the bowel.

There are other forms of inguinal hernia, as scrotal, congenital, and encysted.

Scrotal, is when the bowel has descended into the scrotum. The tumor in this form of hernia may acquire an enormous size.

Congenital, is that form in which the bowel descends in the tunica vaginalis, while it yet communicates with the cavity of the peritoneum.

Encysted, is when the bowel descends behind the tunica vaginalis, carrying with it a pouch of the peritoneum.

The *fascia transversalis* has been observed as forming an important part of the anatomy of inguinal hernia. It lines the internal surface of the transversalis muscle in other portions of the abdominal parietes, where it consists of but little more than a thin, delicate layer of areolar tissue, and requires no particular notice.

The *arteries*, which supply the parietes of the abdomen anteriorly and laterally, are the internal mammary, the lower intercostal, the lumbar, the internal circumflex ilii, the arteria ad cutem abdominis, and the epigastric.

The INTERNAL MAMMARY enters the abdomen beneath the cartilage of the seventh rib, descends a short distance behind the rectus, and then perforates its sheath. While in the sheath, it gives branches to the muscle, and sends off branches which go to supply the integuments and the broad muscles. They inosculate freely with branches of the epigastric.

The INTERCOSTAL leave the intercostal spaces, and pass between the internal oblique and transversalis muscles. They inosculate with the internal mammary, epigastric, and lumbar arteries.

The LUMBAR divide into the posterior and anterior or abdominal branches. The latter pass between the middle layer of the fascia lumborum and the quadratus lumborum muscle, and thence between the internal oblique and transversalis muscles. They anastomose above with the intercostal, in the middle with the internal mammary, and below, with the ilio-lumbar and internal circumflex ilii arteries.

The INTERNAL CIRCUMFLEX ILII, Fig. 151 (14), arises from the external iliac just behind, or a little above Poupart's ligament. It passes upwards and outwards to the anterior superior spinous process of the ilium, where it divides into two branches. One of these ascends between the internal oblique and transversalis, to terminate in the muscles and integument, and to inosculate with the intercostal and internal mammary; the other runs along the crest of the ilium, and anastomoses with the lower lumbar. The arteria ad cutem abdominis has been noticed in connection with the fascia superficialis.

The EPIGASTRIC, Fig. 151 (13), arises from the external iliac, just above Poupart's ligament, passes inwards and upwards behind the inguinal canal, and between the fascia transversalis and peritoneum. It gets behind the rectus, enters its sheath, and passes up to the umbilicus, where, or a little above, it divides into branches to supply the muscle, and to anastomose with the internal mammary. It sometimes gives off the obturator and the internal circumflex ilii. Its usual branches are, a *pubic*, which goes behind the pubis; a *cremasteric*, which enters the inguinal canal, and accompanies the spermatic cord to the testicle; a *branch*, to anastomose with the obturator when it arises from the internal iliac; sometimes this branch is quite large, and passes near the femoral ring. The *origin* of the epigastric is subject to some variation. It may arise from the femoral or from the external iliac, some distance above Poupart's ligament.

The *nerves* which supply the abdominal parietes are the inferior intercostal and the anterior branches of the lumbar.

The INTERCOSTAL NERVES, when they leave the intercostal spaces, pass forwards between the internal oblique and transversalis muscles as far as the rectus, the sheath of which they perforate. Besides muscular branches, they give off two sets of cutaneous branches, the *anterior* and the *lateral*. The *former* leave the sheath of the rectus, and supply the integu-

ment on the front part of the abdomen; the *latter* are given off about midway between the spine and the linea alba, pass

Fig. 151.

A View of the Arteries in the Groin of the Left Side in their relative Positions, the Inguinal Canal being opened.—1. Aponeurosis of the obliquus externus muscle. 2. Section of this muscle. 3. Its tendon turned off and upwards. 4. Its tendon turned downwards and exposing the inguinal canal. 5, 6, 7. Subcutaneous arteries. 8. A branch of the arteria ad cutem abdominis. 9. Surface of the Obliquus internus muscle. 10. Surface of the transversalis muscle. 11. Section of the fascia transversalis. 12. Branch of the epigastric artery. 13. Epigastric artery. 14. Internal circumflex ilii. 15. Lower edge of the transversalis muscle, giving off fibres to form the cremaster. 16. Section of the linea alba. 17. Rectus abdominis muscle. 18. Spermatic cord, entire. 19. An arteriole from the epigastric. 20. Another to the fascia. 21. End of the external iliac artery. 22. The femoral artery. 23. The profunda femoris. 24. External circumflex. 25. A branch to the fascia lata. 26. External pudic artery.

through the internal and external oblique muscles to the skin. When these branches enter the superficial fascia, they divide into anterior and posterior filaments, to anastomose with each other, and also with the posterior spinal nerves.

The *last dorsal nerve* is relatively very large. Its lateral cutaneous branch, after perforating the internal and external oblique muscles, descends to the crest of the ilium, where it

divides into cutaneous branches, which are distributed to the integument in the gluteal region.

The *branches* from the lumbar plexus are the superior and middle musculo-cutaneous.

The SUPERIOR MUSCULO-CUTANEOUS, or ILIO-SCROTAL, Fig. 178 (3), arises from the upper part of the plexus, perforates the psoas magnus, and runs over the quadratus lumborum muscle to the crest of the ilium, where it gets between the transversalis and internal oblique muscles. It divides above the crest into an *abdominal* and *pubic* or an *external* and an *internal* branch. The abdominal branch has a course similar to the intercostal nerves. The pubic division passes above Poupart's ligament, and joins the spermatic cord in the inguinal canal, passes through the external ring, and is distributed to the integument in the pubic region. Sometimes it gives off a cutaneous branch, which passes over the crest of the ilium, and is lost in the gluteal region.

The MIDDLE MUSCULO-CUTANEOUS, Fig. 178 (3), has nearly the same origin and course as the preceding. It generally anastomoses with the superior musculo-cutaneous at the upper portion of Poupart's ligament.

It will be observed that the course of the abdominal nerves is, for the most part, the same, while that of the arteries is quite different. The parietes of the abdomen are abundantly supplied with both nerves and vessels.

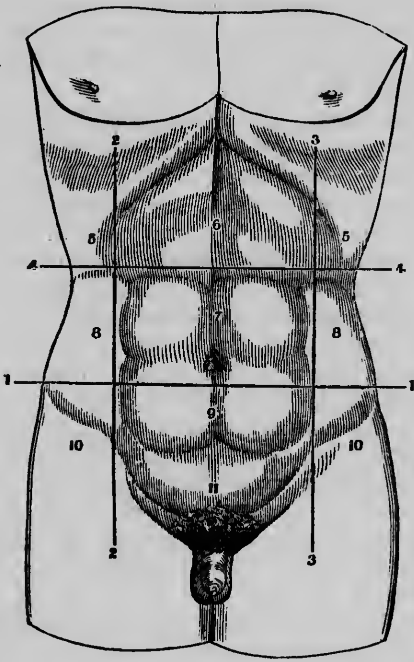
SECT. II.—DISSECTION OF THE CAVITY OF THE ABDOMEN.

To open the cavity of the abdomen, make an incision from the xiphoid cartilage to the umbilicus and a little to one side of the linea alba, and another on each side from the umbilicus to the anterior superior spinous process of the ilium.

This cavity is divided into nine regions, Fig. 152, to which two others are sometimes superadded. Although these divisions are arbitrary, they are still useful for the purpose of locating the different organs in the abdomen. They are found by making two transverse and two vertical lines. The transverse lines extend, the superior from the cartilage of the eighth rib on one side to the corresponding rib on the opposite side, and the inferior from one anterior superior

spinous process of the ilium to the other. The vertical lines are drawn, one on each side, from the cartilage of the eighth rib to the centre of Poupart's ligament. Thus six lateral and

Fig. 152.



SURFACE OF THE ABDOMEN, WITH LINES (1, 2, 3, 4) DRAWN UPON IT, MARKING OFF ITS ARTIFICIAL SUBDIVISIONS INTO REGIONS.—5, 5. Right and left hypochondriac. 6. Epigastric. 7. Umbilical. 8, 8. The two lumbar. 9. Hypogastric. 10, 10. The right and left iliac. 11. Pubic.

three middle regions are formed. The lateral, commencing above, are the *right and left hypochondriac*, the *right and left lumbar*, and the *right and left iliac;* the middle are the *epigastric*, the *umbilical*, and the *hypogastric.*

The other two are named, the *cardiac*, and the *pubic.* The *former* comprises a small space, without any definite boundaries, around the ensiform cartilage; the *latter* is situated just above the pubic bones.

The manner in which these regions are occupied, will be better understood after the viscera have been described. We shall give here merely a general account of the location of the different organs, preparatory to the examination of the peritoneum, and in order that the student may obtain some idea of the position of the different viscera in the abdomen before he proceeds to the study of them separately. He cannot become too familiar with the exact situation and relation of each viscus in this cavity.

In the upper part of the cavity, Fig. 153, and in relation with the diaphragm, are the *liver*, the *stomach*, and the *spleen*. The liver alone occupies the left hypochondriac region; a part of the liver and stomach are situated in the epigastric region; the spleen and a portion of each of the other organs are found in the left hypochondriac region. The *pancreas* is situated behind the stomach, extending from the spleen on the left to the concavity of the duodenum on the right. The *kidneys* are placed in the back part of the lumbar regions. The *cæcum* is in the right iliac region. The *colon* commences at the cæcum, passes upwards through the right lumbar region to the liver, then turns to the left and goes across the upper part of the umbilical, below the liver and stomach, to the left lumbar region, where it is in contact with the spleen; thence it descends, in front of the kidney, to the left iliac region, where, after forming the sigmoid flexure, it enters the pelvis and terminates in the rectum. The *duodenum* begins at the right extremity of the stomach, proceeds about two inches and a half to the right between the liver and colon, turns downwards behind the colon, and then passes to the left through the mesentery, to terminate in the jejunum. The remainder of the small intestine, consisting of the *jejunum* and *ileum*, is found principally in the umbilical region, and terminates in the cæcum.

The PERITONEUM is the largest serous sac in the body. It presents two surfaces, an *external* and an *internal;* the *latter* is smooth and polished, being constantly lubricated with a serous exhalation; the *former*, or external, is everywhere adherent. It is divided into a *visceral* and a *parietal* portion; and different parts of these, as will be seen, are designated by different names.

Above the umbilicus, and in the median line, the *parietal*

portion is reflected upon the remains of the umbilical vein of the fœtus, and forms the suspensory ligament of the liver. Below the umbilicus it presents *three folds* which correspond, in the middle, to the urachus, and on the sides to the umbilical arteries of the fœtus. In some parts it adheres closely to the abdominal parietes, while in others, as in the lumbar and iliac regions, more or less loose areolar tissue intervenes.

The *visceral portion* is rendered somewhat complex by its numerous reflections. To understand it properly, the student cannot rely upon a mere description of it; he must examine it for himself. The best mode of doing this is to study it in its connections with the organs which it invests, and from which it is reflected to the parietes. It is in this way that we shall describe it.

If the *liver* be examined, it will be found that the peritoneum covers nearly the whole of its exterior surface, including a portion of the gall-bladder; and that it is reflected from it at four different places. From its upper and anterior surface in the median line it is reflected to the diaphragm, so as to form a fold which extends from the *ligamentum teres* or the remains of the umbilical vein of the fœtus, which it includes, to the posterior border of the liver. This fold is called the *suspensory ligament*, and indicates the dividing line between the right and left lobes of the liver. At the posterior border it is reflected to the diaphragm, and forms first the *coronary* and then the *right* and *left lateral ligaments;* of the last two the right one is short, and attaches the right lobe closely to the diaphragm, while the left is longer, and allows the left lobe a considerable degree of mobility independently of the diaphragm. From the under surface it is reflected in three laminæ. The *anterior two* form a fold which contains, in its right border, the *hepatic artery* and *duct*, the *portal vein*, the *hepatic plexus of nerves*, and the *deep-seated lymphatics* of the liver, and below, the *stomach*. This fold between the liver and the stomach, is named the *gastro-hepatic omentum*, Fig. 154 (9). These two laminæ leave the convex border of the stomach, pass down in front of the transverse colon, without adhering to it, and descend to the lower part of the abdomen, Fig. 153 (27, 27), where they are reflected on themselves; they then pass upwards to the *transverse colon*, to inclose which they separate, and then reunite and go backwards to the spine, forming the *transverse meso-colon;*

having reached the spine, they again separate, the one to *descend*, to invest the small intestines, and form the *mesentery*, the other to *ascend* over the lower portion of the duodenum, and the pancreas to the under surface of the liver.

Thus it will be seen that the posterior lamina of the gastro-hepatic or lesser omentum passes down behind the stomach to near the lower part of the abdomen, and returns again to the liver, passing over the *transverse colon*, a part of the *duodenum*, and the *pancreas*. It is this lamina which forms the *lesser peritoneal sac.* Although applied to the anterior lamina from the liver to the spine, except where they separate to inclose the stomach and colon, they are nowhere continuous, except at the right border of the gastro-hepatic omentum. If the student will examine this *border*, he will find that the two laminæ of the gastro-hepatic omentum are here continuous around the *hepatic vessels*, and that behind it is an opening which leads into the lesser sac or pouch formed by the posterior lamina. This opening is called the *foramen of Winslow*, Fig. 154 (9).

It is through this *foramen* only that the posterior surface of the stomach, the anterior surface of the transverse colon and the pancreas, and the lobus Spigelii can be reached without destroying the continuity of the peritoneum. It has, *in front*, the hepatic vessels, *behind*, the ascending vena cava, *above*, the lobus Spigelii, and *below*, the superior transverse portion of the duodenum.

The *omentum majus*, or *gastro-colic omentum*, Fig. 153 (27, 27), consists of the two laminæ which have already been described as passing down from the convex border of the stomach in front of the small intestine, and again ascending to the transverse colon. It has been compared to an empty sac within a sac, and although thin and transparent, it consists of two anterior and two posterior laminæ. In the lower part of it the laminæ adhere so closely to each other that it is difficult to separate them, and not unfrequently it presents a cribriform or net-like appearance. It usually descends lower on the left than on the right side. Between its laminæ are found vessels, and more or less adipose substance. Its most probable use is to facilitate the movements of the convolutions of the small intestine on themselves and on the abdominal parietes. In some cases, it extends but a very little distance below the colon.

The whole of the *spleen*, except the hilum, or fissure, through which the vessels enter it, is invested by the peritoneum. It is reflected from the spleen along the splenic vessels to the left extremity of the stomach, where it becomes continuous with the lamina which passes over the anterior surface of that organ. This portion of it is designated the *gastro-splenic omentum.*

Below the spleen, the peritoneum is continued down over the *left extremity* of the transverse colon and the *descending colon*, forming the *descending meso-colon.* From the meso-colon it is reflected on the *left* to the parietes, and on the *right* it is continuous with the anterior lamina of the omentum majus and the mesentery; lower down it is reflected over the *spine*, the *aorta*, the *vena cava*, the *ureter* and *iliac vessels.* It lies *in front* of the *left kidney*, from which it is usually separated by fat, areolar tissue, and partly by the colon.

From the posterior border of the right lobe of the liver it is reflected downwards over the *right kidney*, the *superior transverse portion* of the *duodenum*, the *right extremity* of the *transverse colon*, the commencement of the *inferior transverse portion* of the *duodenum*, the *ascending colon* and *cœcum*, forming the *ascending meso-colon* and the *meso-cœcum.* On the *left*, it joins the anterior lamina of the omentum majus and the mesentery; on the *right*, it joins the parietal portion. The cæcum is sometimes almost wholly covered by peritoneum.

The laminæ of the *ascending* and of the *descending* meso-colon, above the sigmoid flexure, are separated some distance apart, so as to leave the posterior aspects of these portions of the colon uncovered by peritoneum. Thus it is that the large intestine can be punctured without wounding the peritoneum. The laminæ of the *transverse* meso-colon and of the sigmoid flexure in the left iliac region are applied to each other so as to leave just space enough for the vessels and nerves to reach the parietes of the intestine.

The difference in the length of the meso-cola should be observed. That of the transverse colon as well as that of the sigmoid flexure are usually several inches in length, allowing a considerable degree of mobility to those parts of the large intestine.

In the pelvis, the peritoneum is reflected over the *upper*

part of the *rectum* to the parietes forming the *meso-rectum;* it also covers the *upper* and *posterior part* of the *bladder*, from which it is reflected behind to the rectum, and laterally and anteriorly to the parietes, forming the *posterior lateral ligaments* of that organ.

In the female it covers the *anterior upper two-thirds* of the *uterus*, and the whole of it, posteriorly, including the *upper* and *posterior part* of the *vagina.* As it is reflected from the uterus it forms several folds, as the *broad ligaments* laterally, the *recto-uterine* behind, and the *vesico-uterine* in front.

Relations of the Abdominal Viscera.

Before describing the special anatomy of the abdominal viscera, we shall give a brief description of their relations to each other and to the surrounding parts. It is only in the dissecting-room that the student will be able to acquire this knowledge in a manner that will make it satisfactory and useful to himself. The study of the special anatomy of most of the organs will require their removal from the abdominal cavity, which must necessarily destroy their relations to contiguous parts.

In the upper part of the abdomen, Fig. 153, there are three organs, whose relations to the diaphragm, and through it to the lungs and heart in the thorax, should be carefully observed. These are the *liver*, the *stomach*, and the *spleen.* Of these only the *liver* has any direct relation to the right lung. It is received deeply into the concavity of the lung, ascending in expiration as high as the fifth, or even the fourth intercostal space. It necessarily rises and descends alternately in expiration and inspiration.

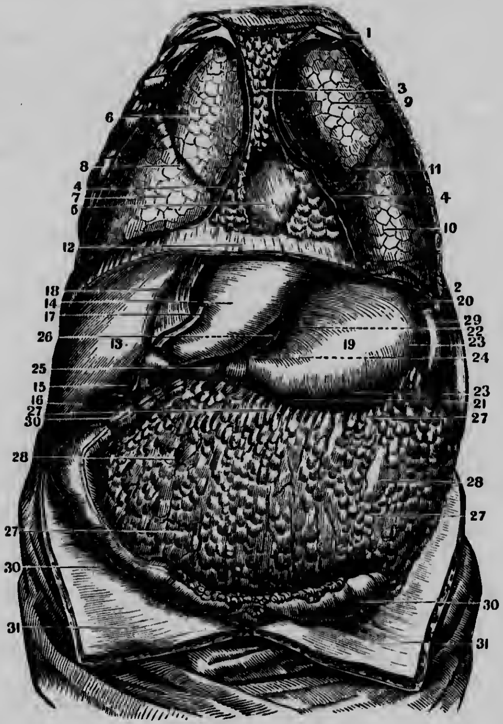
Both the *liver* and the *stomach* are placed in apposition with the central part of the diaphragm, and are separated from the heart only by the cordiform tendon and the adherent portion of the pericardium.

The *spleen*, the *stomach*, and a *small portion* of the left lobe of the liver occupy the concavity of the left part of the diaphragm, and consequently are in relation with the left lung. They do not ascend quite so high as the liver does on the right side.

It will be seen from the position of the liver that if it

should become agglutinated to the diaphragm, a hepatic abscess might open into the pleural cavity above, or if adhe-

Fig. 153.



A View of the Viscera of the Chest and Abdomen, in their Natural Position, as given by the removal of the Anterior Parietes of each Cavity.—1, 2. The ribs forming the side of the chest 3. Fatty tissue in the anterior mediastinum. 4, 4. The section of the pleura of each side. 5. The pericardium inclosing the heart. 6. Superior lobe of the right lung. 7. Inferior lobe of the right lung. 8. The fissure which separates them. 9. Upper lobe of the left lung. 10. Lower lobe of the left lung. 11. Fissure between them. 12. A transverse section of the diaphragm. 13. Superior face of the right lobe of the liver. 14. Superior face of the left lobe of the liver. 15. Lower end of the gall-bladder. 16. Inferior and anterior edge of the liver. 17. Round ligament of the liver. 18. Suspensory ligament of the liver. 19. Anterior face of the stomach. 20. Its greater extremity. 21. Its lesser extremity. 22. Its lesser curvature. 23. Its greater curvature. 24. The pylorus. 25. The duodenum. 26. A part of the gastro-hepatic omentum. 27, 27. The majus omentum. 28, 28. Convolutions of the small intestines, seen through this omentum. 29. The spleen. 30, 30. The large intestines. 31, 31. Parietes of the abdomen turned down.

sions between the diaphragm and the lung should exist at the same time, the pus might find its way into the bronchial tubes. An effusion into the cavity of the pleura would press the liver downwards; or, in case of enlargement of the liver, the lung might be pressed upwards.

Abscesses of the liver may open externally through the intercostal spaces, or lower down through the anterior parietes of the abdomen. The reflections of the pleuræ and of the peritoneum are such, that if an instrument should be carried horizontally backwards through the sixth or seventh intercostal space, it would pass through the *former* eight times and the *latter* four times.

It is mainly through the medium of the liver and stomach that the impulse of the heart is transmitted to the abdominal parietes. The portions of these organs which correspond to the cordiform tendon of the diaphragm are subjected to scarcely any upward or downward movement.

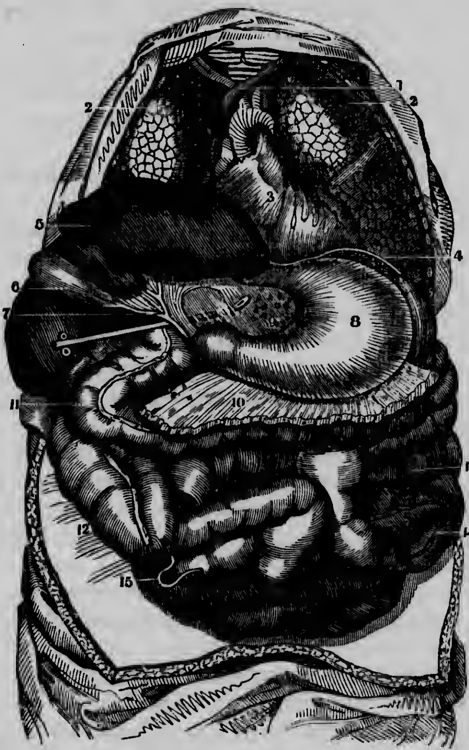
The spleen is pressed on by the contraction of the diaphragm. This sometimes gives rise to pain in this organ after running. If it be enlarged, the pain may be greatly increased. It is in relation with the ninth, tenth, and eleventh ribs, through the medium of the diaphragm, and may be pressed on by them. The *position* of the spleen is deep in the left hypochondriac region, and cannot be reached by pressure upon the external surface of the body, except through the lower ribs, or by pressing the hand upwards underneath them.

The *under surface* of the *liver* is in relation with the right kidney, the upper and right part of the colon, the superior transverse portion of the duodenum, the stomach, and the pancreas. Hence hepatic abscesses may open into the colon, the duodenum, or the stomach. The *gall-bladder* rests on the pylorus or duodenum and the colon, which are frequently stained with bile in the dead subject; gall-stones sometimes escape by ulceration into the colon or duodenum. It corresponds very nearly to the cartilage of the eighth or ninth rib, and is about two inches and a half to the right of the median line or linea alba.

The *anterior surface* of the *stomach* is in relation with the left lobe of the liver, the diaphragm, and the anterior walls of the abdomen. The *posterior surface* corresponds to the pancreas, the splenic vessels, the solar plexus, and the aorta.

Its *left extremity* projects from two to three inches to the left of the cardiac orifice, is in contact with the concavity of the spleen, and is just above the left kidney and renal capsule. Its *cardiac orifice* is situated below the diaphragm, and

Fig. 154.



A VIEW OF THE SAME VISCERA, AFTER THE REMOVAL OF THE FAT IN THE CHEST AND THE OMENTUM MAJUS OF THE ABDOMEN. THE LIVER ALSO HAS BEEN TURNED BACK TO SHOW ITS UNDER SURFACE AND THE LESSER OMENTUM.—1. The great bloodvessels of the heart. 2. The lungs of each side. 3. The heart. 4. The diaphragm. 5. Under surface of the liver. 6. The gall-bladder. 7. Union of the cystic and hepatic ducts to form the ductus choledochus. 8. Anterior face of the stomach. 9. The gastro-hepatic, or lesser omentum. A female catheter has been passed through the foramen of Winslow, and is seen through the omentum. 10. Gastro-colic, or greater omentum, cut off, so as to show the small intestines. 11. The transverse colon, pushed slightly downwards. 12. Its ascending portion, also pushed down. 13. Small intestines. 14. The sigmoid flexure. 15. Appendicula vermiformis.

behind the posterior border of the left lobe of the liver, near the median line. The *pyloric orifice* is situated about three or four inches lower down in the abdomen, and to the right side. It corresponds nearly to the position of the gall-bladder. It is much nearer to the anterior parietes than the cardiac orifice, and hence tumors which have their seat near the pyloric orifice can be more easily felt than when near the cardiac. The *junction* of the stomach and duodenum is indicated by a circular constriction. The *superior* or *concave border* is occupied by the lesser omentum, and looks towards the liver. The *convex border* is in relation with the meso-colon behind, and is occupied with the commencement of the gastro-colic omentum. The position of the stomach is altered somewhat when it is distended. Its anterior surface then looks upwards, and its posterior downwards; its borders are also changed, the convex one is directed forwards, and the concave backwards.

The student may now proceed to examine the connections of the duodenum. This can be done more satisfactorily if it, together with the stomach, be moderately inflated. For this purpose, a pipe may be inserted into the upper part of the jejunum.

The *duodenum* presents three parts for study; a *superior transverse*, a *descending*, and an *inferior transverse portion*. The *first* division commences at the pylorus, and extends about two inches upwards, backwards, and to the right side, in contact with the liver and gall-bladder. It is covered on both sides by peritoneum, and consequently is quite movable. The vena portæ and the ductus choledochus communis pass behind it.

The *descending portion* passes downwards about three inches, having the transverse colon in front and the concave border of the kidney and its vessels behind, the ascending colon on the outer side, and the head of the pancreas on the inner side. This portion is only partly covered by peritoneum. The biliary and pancreatic ducts open into its inner and posterior part near the middle.

The *third division* is situated between the laminæ of the meso-colon. It passes from the right to the left across the right crus of the diaphragm, the vena cava, and the aorta. The pancreas is placed above, and partly separated from it by the mesenteric vessels. It presents a slight bulging below the transverse colon, and near its commencement. Its ter-

mination in the jejunum is seen on the left side of the mesentery. Like the descending portion, it is only partly covered by peritoneum.

The middle and lower portions of the duodenum are so fixed by their connections that they cannot well be displaced unless by the development of a tumor. The first portion may be drawn down more or less by the stomach.

The *small intestine* below the duodenum consists of the *jejunum* and *ileum*. It is convex anteriorly and concave posteriorly. It occupies the umbilical and hypogastric regions, and extends laterally into the lumbar and iliac. It is attached to the posterior wall of the abdomen by the *mesentery*, which extends obliquely across the spine from the left lumbar region downwards to the right iliac. The mesentery is short at its extremities, but much longer in the middle, where it allows a great degree of mobility to the corresponding portion of the intestine. It contains between its laminæ the mesenteric vessels, nerves, and glands. The convolutions of the jejunum and ileum have no regular form. They are in contact with the anterior parietes of the abdomen, except when the omentum majus covers them, and are separated from the viscera above by the transverse colon and its meso-colon. They are usually found partly lodged in the pelvis, where they are in contact with the rectum and bladder, and in the female with the uterus. Their mobility is such that they can adapt themselves to any changes that may take place in the contiguous organs, or in the condition of the abdominal cavity.

The *large intestine* consists of the *cæcum*, *colon*, and *rectum*.

The *cæcum* is situated in the right iliac region. It is attached to the iliac fossa by the meso-cæcum. It varies in length from an inch and a half to three or four inches. It rests on the iliac fascia, and has, in front and on the inner side of it, the convolutions of the small intestine; when distended, it is in contact with the anterior abdominal parietes. The *appendix vermiformis cæci* is joined to it inferiorly. It is a small, hollow, cylindrical body, from two to four inches in length, and bound down by a fold of the peritoneum. The small intestine joins the large at the junction of the cæcum and colon.

The *colon* is divided into the *ascending*, the *transverse*, and the *descending portions*; the latter includes the *sigmoid flexure*.

The *first division* ascends through the right lumbar region

to the under surface of the liver. It lies at first on the anterior layer of the fascia lumborum, and then on the kidney; the vertical portion of the duodenum and the convolutions of the small intestine are placed on the inner side, and the latter also in front of it when it is empty. Externally, it is applied to the wall of the abdomen. The lower part of it can be reached through the lumbar region without implicating the peritoneum.

The *transverse colon*, sometimes called the *arch of the colon*, extends from the inferior surface of the right lobe of the liver to the spleen in the left hypochondriac region, where it is continuous with the descending colon. Its position is below that of the liver, stomach, and spleen. As it crosses the abdomen, it has to ascend to reach the spleen, as that organ is so much smaller than the liver. It is separated from the anterior abdominal parietes by the descending laminæ of the omentum majus. The small intestine is below, and the meso-colon behind it. It frequently has attached to it numerous small pouches of peritoneum, which contain fat. These are called the *appendices epiploicæ*. They are not known to perform any function. The transverse colon is allowed, from its position and attachments, a greater degree of mobility than any other portion of the intestinal canal; hence its direction and situation are subject to marked changes. It is sometimes met with passing down into the hypogastric region, and again ascending to the left hypochondriac.

The *descending colon* passes down through the left lumbar to the left iliac region. Its relations are similar to those of the ascending colon. It is somewhat longer, and is not as much covered by the peritoneum, hence it can be perforated with less danger of wounding the peritoneum; its posterior or non-peritoneal surface also corresponds to the fascia lumborum higher up above the crest of the ilium, on account of the left kidney being situated higher than the right.

The *sigmoid flexure* is generally found partly in the left iliac fossa and partly in the pelvis. It forms a double curve. From the length of its meso-colon it has more mobility than any other portion of the large intestine, except the transverse colon. Its direction is downwards, and from left to right. It is subject to much variation in the length, direction, and position of its flexures. When it is distended with gas or fecal matter,

it is in direct apposition with the walls of the abdomen, and can be felt during life through the parietes; but when it is empty, the convolutions of the small intestine usually intervene. It terminates in the rectum opposite the left sacro-iliac symphysis, without any precise line of demarcation.

Only the *superior part* of the *rectum* can be observed without a dissection of the pelvis. Its relations to the bladder and to the uterus, in the female, may be noticed at the present time, leaving the study of it until the pelvic viscera are examined.

The parts surrounded by the capsule of Glisson, in front of the foramen of Winslow, should now be dissected.

They consist of the *ductus choledochus communis* on the right side, the *hepatic artery* on the left, and the *portal vein* between and behind the duct and artery. The *hepatic plexus* of nerves accompanies the artery. From the ductus choledochus the hepatic duct may be traced to the transverse fissure of the liver, and the cystic duct towards the gall-bladder. The *ductus choledochus* is about two inches and a half in length. Its direction is downwards, backwards, and a little to the right. It passes behind the duodenum to reach the inner and central part of its descending portion. It accompanies, for a short distance, the pancreatic duct, a groove formed in the substance of the pancreas. It perforates the coats of the duodenum, as will be seen at another time, obliquely. The ductus choledochus varies much in size in different subjects. It sometimes acquires very great size from the detention of bile.

The pancreas may be exposed by dividing the descending laminæ of the omentum majus a little distance below the convex border of the stomach and turning that organ upwards. The middle portion of it is brought into view by simply dividing the gastro-hepatic omentum.

The *pancreas* is situated behind the stomach, and is covered by the ascending lamina of the transverse meso-colon. It extends from the spleen to the descending portion of the duodenum, being from six to seven inches in length. The *duodenal* extremity, from its size, is sometimes called the *head* of the pancreas. It fills the concavity of the duodenum, and adheres closely to it. The splenic end is named the *tail*, and the middle part the *body*. The cœliac artery projects forwards

above its *upper border*, and gives off the splenic, gastric, and hepatic arteries, both of which run along its upper edge, the former to the spleen, and the latter to the liver. It corresponds *behind* to the vena portæ, the vena cava, the aorta, the crura of the diaphragm, and also to the superior mesenteric artery and vein, which form in it quite a deep sulcus. Its *left* or *splenic* extremity rests on the superior extremity of the left kidney and the supra-renal capsule.

The *excretory duct* of the pancreas runs the whole length of the gland. It joins the ductus choledochus a short distance before the latter opens into the duodenum, so that the two ducts open by a common orifice. Sometimes there is a small pancreatic duct which opens either into the large one, or separately. It is better that the duct of the pancreas should be examined, at least partially, before the gland is removed from the abdomen.

If the pancreas becomes enlarged from disease, it may press upon the vessels beneath it, retarding the circulation through them. The arteries may, at the same time, communicate a pulsatory movement to the tumor, which might give rise to the impression that there was an aneurism. Its relations to the stomach are important. It may, by chronic inflammation, become so agglutinated to the posterior wall of that organ, that when it is perforated by ulceration the pancreas will prevent the escape of its contents. Scirrhus of the pancreas might be mistaken for that of the pylorus.

The *kidneys* are situated in the lumbar regions, the left a little higher than the right. Each lies on the anterior lamina of the fascia lumborum, which separates it from the quadratus lumborum muscle, and on the diaphragm by which it is separated from the lower two or three ribs. The ascending colon lies in front of the right, and the descending colon in front of the left. The liver is in relation with the upper extremity of the right, and the spleen with that of the left. Each one is separated from the spine by the psoas magnus, and the right one also by the vertical portion of the duodenum. They are usually surrounded by considerable fat and areolar tissue. Sometimes the peritoneum comes in direct contact with their anterior surfaces; the colon, in that case, is placed to the inner side of them. The *supra-renal capsule* is situated on the upper extremity of the kidney.

The *ureters* should now be traced from the kidneys into

the pelvis. Each one has a direction downwards and inwards along the psoas magnus, until it reaches the common iliac artery, which it passes over, and also the sometimes external iliac, to enter the pelvis. It is covered by the peritoneum, and has the spermatic vein and artery crossing over, and the genito-crural nerve passing behind it.

Before the viscera are removed from the abdomen for dissection, the vessels and nerves which supply them should be carefully examined. The *arteries* are, the cœliac, the superior and inferior mesenteric, the capsular, and the renal. The *veins* correspond very nearly to the arteries; and all of them, except the renal, belong to the portal system. The *nerves* are derived from the pneumogastric and the sympathetic.

In the dissection of the vessels of the abdominal viscera, no rule can be laid down for the guidance of the student that will be of much service to him. Before commencing their dissection, he should read carefully a description of each one of them, and ascertain very nearly its origin, position, and direction. He will then be able to place the parts in the position most favorable for getting at and tracing them. In exposing the cœliac artery and its branches, it may be found necessary to change the position of the stomach several times; and the same may be required in the case of organs concerned in the dissection of other arteries. In tracing the vessels which are distributed to the stomach and intestines, much assistance may be derived from a partial inflation of these organs.

As the arteries are, for the most part, accompanied by veins and plexuses of nerves which must be dissected at the same time, they will be described in connection. It should be remarked here, that if the student should wish to acquire a thorough and minute knowledge of the nerves in the abdomen, he should obtain a subject for this purpose alone.

The Cœliac Artery, Fig. 155, *b*, and Fig. 159 (2), is given off from the aorta, just below the opening in the diaphragm, and between the crura of that muscle. It is from one-half to three-fourths of an inch in length, and projects almost directly forwards. It is surrounded by the solar plexus, and has one of the semilunar ganglia on each side of it.

The Solar Plexus, Fig. 142 (90), consists of a network of nerves, placed in front of the crura of the diaphragm and the aorta, and around the cœliac artery. It receives fila-

ments from the splanchnic nerves and the right pneumogastric nerve. It gives off the *hepatic*, the *splenic*, the *gastric*, the *phrenic*, the *superior mesenteric*, and the *renal plexuses*. Each one of these plexuses should be observed, when the artery which it accompanies is dissected.

The SEMILUNAR GANGLIA are the largest in the body. They are situated one on each side of the solar plexus, behind and above the supra-renal capsule, and resting on the diaphragm and aorta. Although called semilunar, they are very irregular in shape, frequently consisting of several small masses connected by filaments. The great splanchnic nerves terminate in them. They are joined to each other by the solar plexus.

The cœliac artery has no corresponding vein. It divides into three large branches, the splenic, the gastric, and the hepatic. It is sometimes called the *cœliac axis;* and its three branches the *tripod of Haller.*

The SPLENIC ARTERY, Fig. 155, *i*, runs along the upper border of the pancreas to the hilum of the spleen, where it divides into several branches to be distributed to that organ. It is much longer than the distance from its origin to the spleen, hence it is very tortuous, although nearly horizontal in its general direction. It furnishes branches to the pancreas and stomach.

The *pancreatic branches* are given off to the pancreas as it runs along the upper border of the gland. Near the left extremity, one branch, larger than the others, penetrates the gland, and, joining the duct, accompanies it to the right.

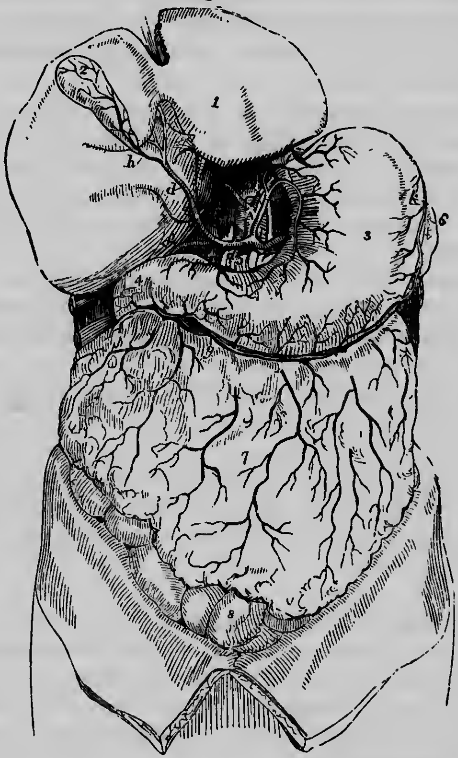
The *left gastro-epiploic*, Fig. 155, *k*, turns to the right, and runs some distance along the convex border of the stomach, where it anastomoses with the right gastro-epiploic artery. In its course it sends branches to both sides of the stomach and to the omentum majus.

The *vasa brevia* consist of several branches, which arise from the terminal divisions of the splenic artery. They go to the left extremity of the stomach, where they anastomose with branches of the gastric artery.

The SPLENIC VEIN, Fig. 157, *b*, commences in the hilum of the spleen, by the union of branches which originate in the cells of that organ. It receives branches which corre-

spond to those given off by the splenic artery to the stomach and pancreas. The inferior mesenteric vein also empties into

Fig. 155.



The Viscera of the Upper Part of the Abdomen, with the Cœliac Artery and its Branches, are represented in this sketch.—1. Liver. 2. Gall-bladder. 3. Stomach. 4. Its pyloric end. 5. Pancreas. 6. Spleen. 7. Great omentum. A. Aorta. *a.* Phrenic arteries. *b.* Cœliac. *c.* Coronary of stomach. *d.* Hepatic. *e.* Superior pyloric. *f.* Gastro-duodenal. *g.* Right gastro-epiploic. *h.* Cystic artery to gall-bladder. *i.* Splenic. *k.* Left gastro-epiploic.

it. It is situated, in its course, behind the splenic artery and the pancreas. It is not tortuous like the artery, but is much larger. It joins the superior mesenteric vein beneath the pancreas, and a little to the left of the ascending vena cava.

The Splenic Plexus is derived from the cœliac or solar plexus. It accompanies the splenic artery, upon which its filaments may be readily traced. It gives off filaments to the pancreas and to the left extremity of the stomach. The latter form the *left gastro-epiploic plexus*, which accompanies the artery of the same name. The plexus terminates in the substance of the spleen.

The Gastric or Superior Coronary Artery, Fig. 155, *c*, passes between the laminæ of the gastro-hepatic omentum to the cardiac orifice of the stomach, it then turns to the right and runs along its upper or concave border to near the pylorus, where it anastomoses with the superior pyloric, a branch of the hepatic. It gives off branches to both sides of the stomach and to the lower part of the œsophagus.

The *superior coronary vein* commences at the lower part of the œsophagus and left extremity of the stomach, and accompanies the coronary artery along the upper border of the stomach to the pylorus, where it empties into the vena portæ. It receives in its course branches from both sides of the stomach.

The *coronary plexus* is formed by filaments derived from the upper part of the solar plexus, but chiefly from the pneumogastric on the right side. Its filaments are distributed to the stomach along with the branches of the coronary artery.

The Hepatic Artery, Fig. 155, *d*, goes transversely to the pylorus, and then enters the capsule of Glisson in the right border of the gastro-hepatic omentum, and passes upwards to the transverse fissure of the liver. It is smaller than the splenic, but larger than the gastric artery. It gives off the following branches:—

The *superior pyloric*, Fig. 155, *e*, arises near the pylorus, runs a short distance on the upper border of the stomach, and anastomoses with the superior coronary artery; it sends twigs to the sides of the stomach.

The *gastro-duodenal*, Fig. 155, *f*, passes downwards behind the duodenum near the pylorus, and divides into the pancreatico-duodenal and the right gastro-epiploic. Before it divides, it gives off the *inferior pyloric branches* to the pylorus.

The *pancreatico-duodenal* is distributed to the head of the

pancreas and the duodenum, between which it runs some distance. It also gives off a branch to anastomose with one from the superior mesenteric artery.

The *right gastro-epiploic*, Fig. 155, *g*, turns to the left, runs along the convex border of the stomach, and anastomoses with the left gastro-epiploic. It gives ascending branches to both sides of the stomach, and descending to the omentum majus.

The *cystic artery*, Fig. 155, *h*, arises from the right division of the hepatic in the transverse fissure of the liver. It goes to the gall-bladder, and divides into two branches, which ramify on its sides.

There is no vein that corresponds to the hepatic artery. The veins which accompany its branches empty into the vena portæ. The blood which is conveyed to the liver by the hepatic artery enters plexuses formed by the portal vein in the substance of that organ.

The HEPATIC PLEXUS follows both the hepatic artery and portal vein to the liver; hence it has been divided into the anterior and posterior plexus. The former is derived from both of the semilunar ganglia, and from the right pneumogastric nerve; the latter comes principally from the left semilunar ganglion. The left pneumogastric nerve sends filaments to join the plexus in the gastro-hepatic omentum. The hepatic plexus ramifies in the substance of the liver, accompanying the divisions of the hepatic artery and portal vein. It also gives off secondary plexuses, which follow the branches of the hepatic artery to the pylorus, the convex border of the stomach, the pancreas, and the gall-bladder. They are named the *pyloric*, the *gastro-duodenal*, the *right gastro-epiploic*, the *pancreatico-duodenal*, and the *cystic plexuses*.

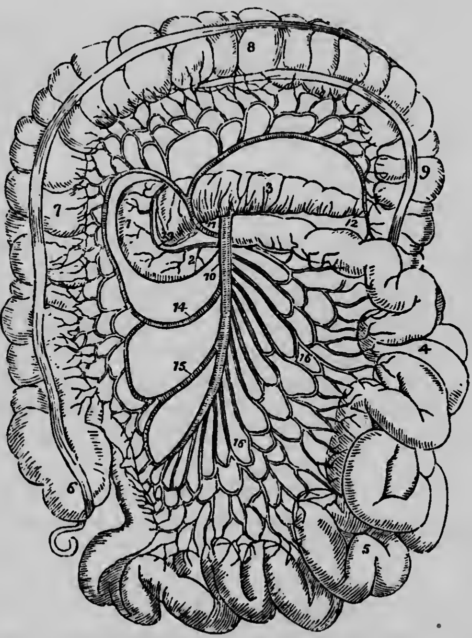
The SUPERIOR MESENTERIC ARTERY, Fig. 156 (10) and Fig. 159 (9), arises from the aorta just below the cœliac artery. Its origin is concealed by the pancreas, which should be turned upwards and fastened with hooks. It passes downwards in front of the inferior transverse portion of the duodenum to the commencement of the attached border of the mesentery, between the laminæ of which it continues down to the junction of the small with the large intestine. In its course it forms a curve with the convexity to the left, and

the concavity to the right. It supplies the whole of the small intestine with the exception of the upper part of the duodenum, the cæcum, the ascending, and about one-half of the transverse colon. Its branches are the following:—

The *pancreatico-duodenalis*, Fig. 156 (13), is given off beneath the pancreas. It sends twigs to the pancreas and the duodenum, and anastomoses with a branch of the same name from the hepatic artery.

The *branches to the small intestine*, Fig. 156 (16, 16), are

Fig. 156.



The Course and Distribution of the Superior Mesenteric Artery.—1. The descending portion of the duodenum. 2. The transverse portion. 3. The jejunum. 4. The pancreas. 5. The ileum. 6. The cæcum, from which the appendix vermiformis is seen projecting. 7. The ascending colon. 8. The transverse colon. 9. The commencement of the descending colon. 10. The superior mesenteric artery. 11. The colica media. 12. The branch which inosculates with the colica sinistra. 13. The branch of the superior mesenteric artery, which inosculates with the pancreatico-duodenalis. 14. The colica dextra. 15. The ileo-colica. 16, 16. The branches from the convexity of the superior mesenteric to the small intestines.

from fifteen to twenty in number. They arise from the convexity of the artery, and after passing a short distance nearly parallel to each other, between the layers of the mesentery, each one bifurcates. By the inosculation of these bifurcations with each other, a series of arches, or one continuous arch, is formed, from the convexity of which another set of branches arise. These, much more numerous than those which arise directly from the artery, inosculate with each other, and form a second series of arches, from the convexity of which another set of branches arise and inosculate with each other. By the repetition of this process the third, fourth, and sometimes the fifth series of arches are formed by the time the middle portion of the small intestine is reached. Having reached the intestine, the last branches divide into two sets, which ramify on the opposite sides of the bowel; some of them between the serous and muscular coats; others perforate the muscular layer, and terminate in the mucous membrane.

To dissect the arteries to the small intestine, the mesentery should be spread out and made tense. It is not necessary that the student should dissect all of them, in order to understand their general arrangement.

The *branches to the large intestine* arise from the concavity of the main trunk. There are three in number, the iliocolic, the right colic, and the middle colic. They pass between the layers of the meso-colon, and bifurcate to form a single series of arches, from which branches proceed to the large intestine, upon which they ramify in the same manner as the arteries do on the small intestine.

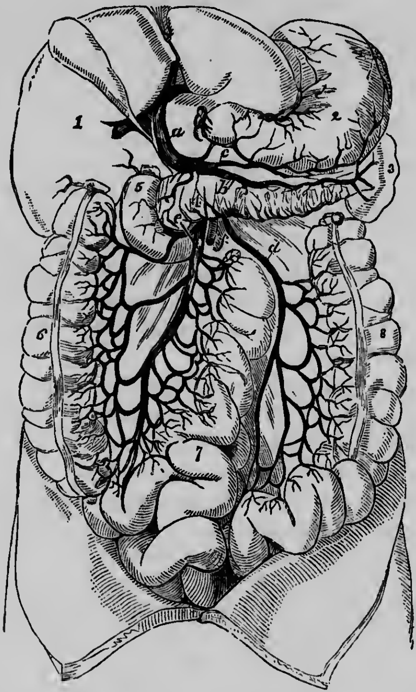
The *ileo-colic*, or *inferior colic*, Fig. 156 (15), descends to the cæcum to divide into branches, to be distributed to the lower part of the ileum, the cæcum, the appendix vermiformis cæci, and the lower part of the ascending colon. It sends a branch upwards to anastomose with the right colic.

The *right colic*, Fig. 156 (14), or, according to some, the *middle colic*, goes horizontally to the ascending colon, and divides into an ascending and a descending branch, to anastomose, the one with the middle colic, and the other with the ileo-colic.

The *middle colic*, or the *superior colic*, Fig. 156 (11), proceeds upwards to the right half of the colon, and like the preceding, divides into two branches. One of these anasto-

moses with the ascending branch of the right colic, and the other with the left colic branch of the inferior mesenteric artery.

Fig. 157.



A View of the Portal System.—1. The liver. 2. The stomach. 3. The spleen. 4. Tho pancreas. 5. A section of the duodenum. 6. The ascending colon. 7. The small intestines. 8. The descending colon. *a.* The portal vein. *b.* The splenic vein. *c.* The right gastro-epiploic. *d.* The inferior mesenteric. *e.* The superior mesenteric. *f.* Section of the superior mesenteric artery.

The Superior Mesenteric Vein, Fig. 157 (*e*), corresponds to the artery just described, and originates in that portion of the intestine which is supplied by that artery. Its main trunk passes upwards over the inferior transverse portion of the duodenum, and beneath the pancreas where, in front of the aorta and to the left of the ascending vena cava, it unites with the splenic vein to form the vena portæ. Its branches are the same as those of the artery which it accompanies.

The SUPERIOR MESENTERIC PLEXUS, Fig. 142 (16), proceeds from the lower part of the solar plexus. The nervous cords in it are large and numerous, forming a sheath for the trunk of the artery. It divides into secondary plexuses, corresponding to the divisions of the mesenteric artery. In the mesentery, the filaments are long, slender, and straight. Some of them unite to form arches just before they penetrate between the coats of the intestine. This is the largest plexus in the body.

The INFERIOR MESENTERIC ARTERY, Fig. 155 (11), and 158 (9), arises from the aorta, from one to two inches above its bifurcation into the common iliacs. It passes downwards along the aorta, and across the left common iliac, to enter the pelvis. It is much smaller than the superior mesenteric. It supplies the left portion of the transverse colon, the descending colon, the sigmoid flexure, and the upper part of the rectum. In its course it sends off the following branches:—

The *left colic artery*, Fig. 158 (10), passes over the left kidney, between the layers of the meso-colon, to the descending colon. It divides into an ascending and descending branch. The former anastomoses with the middle colic branch of the superior mesenteric, thus establishing a free anastomotic connection between the two mesenteric arteries; the latter joins the sigmoid artery below.

The *sigmoid arteries*, Fig. 158 (12), proceed transversely to the sigmoid flexure, and divide into branches to anastomose above with the left colic, and below with the superior hemorrhoidal.

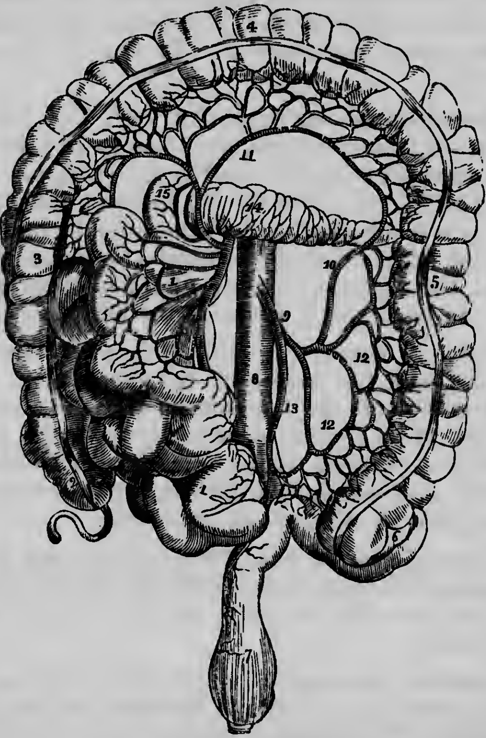
The *superior hemorrhoidal artery*, Fig. 158 (13), passes to the upper part of the rectum, between the laminæ of the meso-rectum. Its branches anastomose with the sigmoid above, and the middle hemorrhoidal below.

The INFERIOR MESENTERIC VEIN, Fig. 153, *d*, is formed by branches which correspond to those of the inferior mesenteric artery. A free anastomosis exists between the superior and middle hemorrhoidal veins. It passes upwards to empty into the splenic vein behind the pancreas. Sometimes it opens into the superior mesenteric vein.

The INFERIOR MESENTERIC PLEXUS, Fig. 142 (16), is de-

rived from the aortic plexus. It supplies that portion of the large intestine to which the inferior mesenteric artery is distributed.

Fig. 158.



The Distribution and Branches of the Inferior Mesenteric Artery.—1.1. The superior mesenteric artery, with its branches and the small intestines turned over to the right side. 2. The cæcum and appendix cæci. 3. The ascending colon. 4. The transverse colon raised upwards. 5. The descending colon. 6. Its sigmoid flexure. 7. The rectum. 8. The aorta. 9. The inferior mesenteric artery. 10. The colica sinistra, inosculating with 11, the colica media, a branch of the superior mesenteric artery. 12, 12. Sigmoid branches. 13. The superior hæmorrhoidal artery. 14. The pancreas. 15. The descending portion of the duodenum.

The Spermatic Arteries, Fig. 159 (10), usually arise a little below the renal, from the forepart of the aorta. Each

descends on the side of the spine, and over the psoas magnus and iliacus internus muscles to the internal inguinal ring, where it joins the spermatic cord. They cross the ureters, and are accompanied by the spermatic veins. In the female, they go to the ovaries, and are called the *ovarian arteries.* There are sometimes two on the same side. The right one occasionally passes beneath the vena cava. They supply the testicles.

The SPERMATIC VEINS in the abdomen accompany the spermatic arteries. The *left* one usually terminates in the renal, and the *right* one in the ascending vena cava. The *latter* passes beneath the right and lower portion of the mesentery, and the *former* beneath the sigmoid meso-colon.

The SPERMATIC PLEXUS accompanies the spermatic artery to the testicle. In the female, the corresponding plexus follows the ovarian artery to the ovary and the uterus. It is derived from the renal plexus.

The RENAL ARTERIES, Fig. 159 (7), sometimes called the emulgent arteries, arise from the aorta opposite to the kidneys. They are very large in proportion to the size of the organs which they supply. The right one is longer than the left, and passes beneath the vena cava. The corresponding veins are usually situated in front of them. When the arteries reach the fissures of the kidneys, they divide into several branches. Sometimes, instead of one there will be two or three on the same side. They are also subject to considerable variation in their origin.

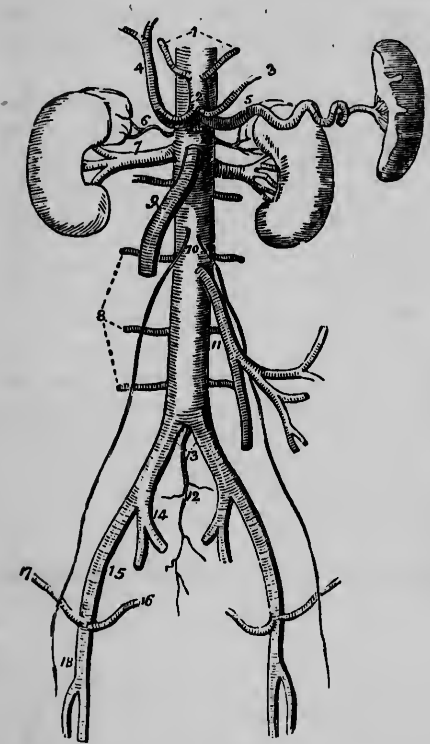
The RENAL VEINS convey the venous blood from the kidneys to the ascending vena cava. The left is the longest, and passes over the aorta; it also receives the *left spermatic vein.* The veins are in front of the corresponding arteries. They open into the vena cava at right angles. The supra-renal vein on the left side usually opens into the renal of the same side.

The RENAL PLEXUS, Fig. 142 (14), is formed on each side by filaments from the solar plexus and from the lesser splanchnic nerve. It accompanies the renal artery to the kidney.

The SUPRA-RENAL ARTERIES, Fig. 159 (6), arise from the

sides of the aorta, sometimes from the phrenic or renal. They supply the supra-renal capsules and the surrounding adipose tissue.

Fig. 159.



The Abdominal Aorta with its Branches.—1. The phrenic arteries. 2. The cœliac axis. 3. The gastric artery. 4. The hepatic artery, dividing into the right and left hepatic branches. 5. The splenic artery, passing outwards to the spleen. 6. The supra-renal artery of the right side. 7. The right renal artery, which is longer than the left, passing outwards to the right kidney. 8. The lumbar arteries. 9. The superior mesenteric artery. 10. The two spermatic arterics. 11. The inferior mesenteric artery. 12. The sacra media. 13. The common iliacs. 14. The internal iliac of the right side. 15. The external iliac artery. 16. The epigastric artery. 17. The circumflex ilii artery. 18. The femoral artery.

The Supra-Renal Veins open, the right into the vena cava, and the left into the renal vein.

Dissection of the Viscera.

The viscera which have been examined *in situ*, can now be removed from the abdomen for the purpose of dissecting them, and studying their structure. The small intestine below the duodenum, and the large above the rectum,

should be removed first. To do this, apply two ligatures around the jejunum, at its commencement, and also two around the lower end of the sigmoid flexure of the colon, and divide the intestine between the ligatures at each place. To detach them will require a division of the mesentery, the meso-cæcum, and the meso-colon, including the omentum majus. These may be laid aside until the stomach and duodenum have been removed and examined.

To remove the stomach, apply two ligatures to the duodenum, about an inch from the pylorus, and divide it between them; then apply a ligature to the œsophagus as it passes through the diaphragm, and divide it above the ligature. The spleen may be taken out with the stomach, or by itself. The pancreas and the remaining portion of the duodenum should be removed together. In dissecting them out, care should be taken not to injure the aorta and vena cava.

The stomach and the intestines should be emptied of their contents, and thoroughly cleansed before they are examined. This may be done by filling them repeatedly with water, or by allowing the water to flow through them from the stop-cock of a hydrant.

The Stomach.

To study the external appearance of the *stomach* it should be inflated. It has a conical form, being curved upon itself. Its *apex* is cylindrical, and joins the duodenum, where there is a slight constriction. Its *base* is rounded, and projects from two to three inches beyond the cardiac orifice. This portion has been designated the *great cul-de-sac*, or *great tuberosity*, Fig. 160, *c*, of the stomach. Near the pyloric extremity, and on the convex side,

Fig. 160

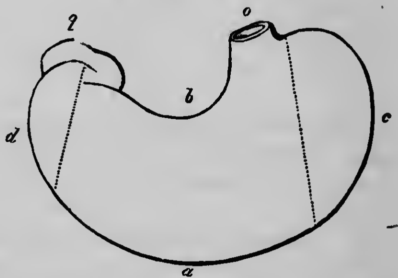


Diagram Outline of Stomach.—*a*. Great curvature. *b*. Lesser curvature. *c*. Left end, great cul-de-sac or fundus. *d*. Small cul-de-sac or antrum pylori. *o*. Œsophageal orifice or cardia. *q*. Duodenal orifice or pylorus.

is a dilatation called the *small cul-de-sac*, Fig. 160, *d*. Instead of there being a constriction around the cardiac orifice, as there is around the pyloric, the œsophagus expands somewhat as it joins the walls of the stomach.

The stomach is everywhere covered by peritoneum, except a narrow space along each of its borders where the laminæ of the greater and lesser omenta are separated for the transmission of vessels and nerves. This space is diminished in size when the stomach is distended.

Perhaps no organ in the body is subject to greater variation in size than the stomach. This is owing, probably, in a great measure, to the habits of the individual in regard to eating. Its coats being very dilatable, yield to a distending force, which may be exerted by the introduction of large quantities of food into the stomach until it has acquired an enormous capacity. It is not unfrequently found very much contracted in the dead subject. It also varies considerably in its relative dimensions, being much longer and narrower in some cases than in others.

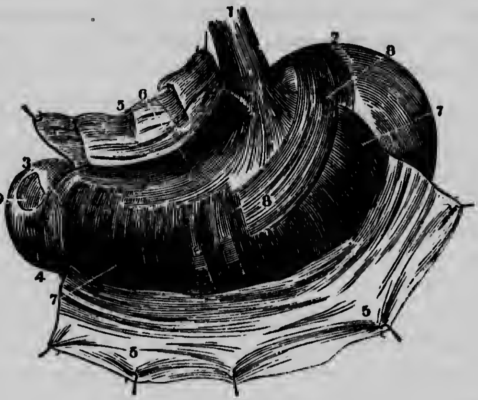
The stomach has four different layers in its parietes. These differ from each other in structure and in function. In addition to these, it has bloodvessels, nerves, and lymphatics. The layers are a mucous, a fibro-cellular, a muscular, and a serous or peritoneal.

The Serous Coat, as has been seen, is a portion of the peritoneum. It furnishes to the stomach a perfectly smooth surface, which is constantly lubricated with a serous exhalation which prevents the occurrence of friction in its movements on contiguous surfaces. It also adds strength to its parietes, and, by its reflections, assists in keeping it in its place.

The Muscular Coat consists of longitudinal, circular, and oblique fibres. To expose these, the serous layer should be removed while the stomach is distended with air. This is to be done partly by tearing and partly by dissecting it off. Frequently, when the stomach is inflated, the fibres can be very distinctly seen without any dissection. This is the case, especially when the muscular layer is strongly developed. The muscular fibres of the stomach belong principally to the non-striated or involuntary class.

The *longitudinal fibres*, Fig. 161 (6), are placed next to the serous coat. If a portion of the œsophagus be inflated with

Fig. 161.



A FRONT VIEW OF THE STOMACH, DISTENDED BY AIR, WITH THE PERITONEAL COAT TURNED OFF.—1. Anterior face of the œsophagus. 2. The cul-de-sac, or greater extremity. 3. The lesser or pyloric extremity. 4. The duodenum. 5, 5. A portion of the peritoneal coat turned back. 6. A portion of the longitudinal fibres of the muscular coat. 7. The circular fibres of the muscular coat. 8. The oblique muscular fibres, or muscle of Gavard. 9. A portion of the muscular coat of the duodenum, where its peritoneal coat has been removed.

the stomach, they will be seen to be a continuation of the longitudinal fibres of that tube. They are most numerous along the concave border and near the pylorus, from which they are continued on to the small intestine.

The *circular fibres*, Fig. 161 (7), pass round the circumference of the stomach from the cardiac to the pyloric orifice. They increase in number towards the pylorus. Around the pyloric orifice they are collected into a sphincter which is capable of closing that opening, so as to prevent the passage of the contents of the stomach into the duodenum during the time of its contraction.

The *oblique fibres*, Fig. 161 (8), which are sometimes absent or very indistinct, pass from one side of the stomach to the other around the great *cul-de-sac* to the left of the cardiac orifice.

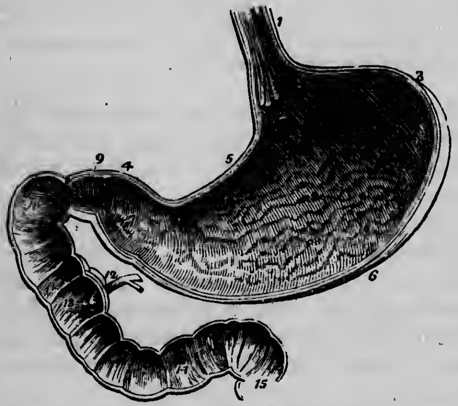
The FIBRO-CELLULAR COAT is placed between the muscu-

lar and mucous, to the former of which it is closely connected by processes which are sent in between its fibres. The arteries and nerves, after passing through the muscular coat, ramify in this. By its density and intimate connection with the muscular layer, it contributes much to the strength of the walls of the stomach. It has been regarded by some as the framework of this organ.

The MUCOUS COAT, Fig. 162, should be examined when the stomach is everted and inflated, and also when everted but not distended. It glides freely on the fibro-cellular layer to which it is applied, and hence when the stomach is empty and contracted, it is thrown into numerous *folds* or *rugæ*, which disappear again when the organ is distended. The principal part of these folds have a longitudinal direction. There are, however, some which intersect these obliquely, and others transversely.

At the *cardiac orifice*, when the stomach is empty, the folds of the mucous membrane present a stellated appear-

Fig. 162.



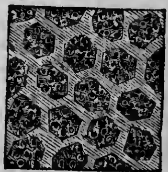
A VERTICAL AND LONGITUDINAL SECTION OF THE STOMACH AND DUODENUM, MADE IN SUCH A DIRECTION AS TO INCLUDE THE TWO ORIFICES OF THE STOMACH.—1. The œsophagus; upon its internal surface the plicated arrangement of the cuticular epithelium is shown. 2. The cardiac orifice of the stomach, around which the fringed border of the cuticular epithelium is seen. 3. The great end of the stomach. 4. Its lesser or pyloric end. 5. The lesser curve. 6. The greater curve. 7. The dilatation at the lesser end of the stomach, which has received from Willis the name of antrum of the pylorus. This may be regarded as the rudiment of a second stomach. 8. The rugæ of the stomach, formed by the mucous membrane: their longitudinal direction is shown. 9. The pylorus. 10. The oblique portion of the duodenum. 11. The descending portion. 12. The pancreatic duct and the ductus communis choledochus close to their termination. 13. The papilla upon which the ducts open. 14. The transverse portion of the duodenum. 15. The commencement of the jejunum. In the interior of the duodenum and jejunum the valvulæ conniventes are seen.

ance, and where the mucous membrane of the œsophagus joins that of the stomach, its epithelium exhibits a fringed or festooned border, Fig. 162 (2). There is no circular fold or sphincter muscle at this orifice as there is at the *pyloric*, where the mucous membrane projects inwards from the circumference of the opening between the stomach and the duodenum, so as to form a partial septum between the cavities of these organs. With the aid of the circular fibres contained between the laminæ of this fold, it is capable of closing the orifice which it surrounds. If the stomach and duodenum be inflated and dried, a good view of this fold, with the circular aperture in its centre, may be obtained. The laminæ of which it is composed resemble, in their organization, the one the gastric, the other the duodenal mucous membrane.

The *color* of the mucous membrane of the stomach varies in health as well as in disease. In the very young, it has a bright reddish tint, while in the aged it usually presents a dark-grayish appearance. It is found of a brighter red if death has occurred when it was full and during the process of digestion than if when empty and free from vascular excitement. Its color is also frequently modified by the presence of bile, or by the action of the gastric juices.

The mucous membrane has not the same thickness and vascularity in every part of the stomach; being thicker towards the pyloric, and more vascular towards the cardiac orifice. There seems to be, also, some difference in susceptibility to disease in its right and left portions.

Fig. 163.



View of the Cells of the Mucous Membrane of the Human Stomach, magnified 32 diameters.—After Dr. Sprott Boyd. The hexagonal cells with their intermediate elevated margins, and the mouths of the tubuli at the bottom of each, are shown.

Papillæ may be observed with the aid of a lens on the mucous surface in all parts of the stomach. They are more numerous, however, in the pyloric than in the cardiac extremity. They are separated from each other by *cells*, or *alveoli*, in which may be seen the *mouths* of small tubes. These tubes are lined by a columnar epithelium. They are supposed to secrete the gastric juices.

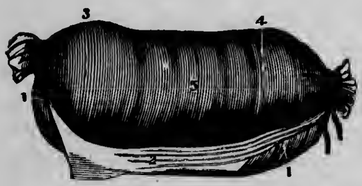
The vessels and nerves of the stomach were examined before it was removed from the abdomen.

The Small Intestine.

The small intestine is divided into three portions: the *duodenum*, the *jejunum*, and the *ileum*. This division is wholly arbitrary, and practically is of little value. The small intestine is about twenty feet in length. It diminishes in size, and in the thickness of its coats, from its commencement to its termination. Its structure is similar to that of the stomach, being composed of a serous, a muscular, a cellular, and a mucous coat.

The Serous Coat consists principally of a single duplicature of the peritoneum, between the laminæ of which the vessels and nerves reach the intestine along its concave or attached border. The duodenal portion of the intestine is not entirely invested with a serous layer, as was observed in the examination of it *in sitû*.

Fig. 164.



A View of the Muscular Coat of the Ileum.—1, 1. The peritoneal coat. 2. A portion of this coat turned off and showing a portion of the longitudinal fibres of the muscular coat adherent to it. 3, 4, 5. The circular muscular fibres in different parts of the intestine.

The Muscular Layer, Fig. 164, is composed of a *longitudinal* and a *circular* set of fibres. The action of the bowel in propelling forward its contents, depends mainly on the circular fibres, which are much more numerous than the longitudinal. They do not, all of them at least, extend entirely around the circumference of the intestine. To obtain a good view of the longitudinal fibres, a section of the intestine should be inflated, and the peritoneum carefully dissected or peeled off. They will be found more numerous on the convex than on the concave border of the bowel.

The Cellular Layer is interposed between the muscular and mucous layers, between which it forms a bond of union, allows the latter to glide freely on the former, and furnishes a medium for the transmission and subdivision of the vessels and nerves supplied to the mucous membrane.

This layer can be very satisfactorily demonstrated by everting a portion of the intestine and then forcibly distending it with air. The preparation should be dried, and the mucous membrane afterwards removed.

The Mucous Membrane of the small intestine should be carefully observed by the student. He should become perfectly familiar with the appearance of it as seen in the dissecting room, where he will have an opportunity of examining it in a healthy as well as in a diseased condition. The following should be particularly noticed: The valvulæ conniventes, the common orifice of the pancreatic and biliary ducts, the villi, the glands of Lieberkühn, Brunner, Peyer, and the glandulæ solitariæ.

The Valvulæ Conniventes, Fig. 162 (15), are permanent, crescentic folds of the mucous membrane, extending from one-half to two-thirds around the circumference of the intestine. They are most prominent in the lower part of the duodenum and in the jejunum, while in the upper part of the duodenum and in the lower part of the ileum they are usually absent. They increase the extent of mucous surface, and also serve to retard the passage of the food through the intestine.

The Orifice of the *ductus choledochus communis*, and the *pancreatic duct*, Fig. 162 (13), is situated on the summit of a small eminence at the lower part of the descending portion of the duodenum, and about three inches and a half from the pylorus. It is readily observed when the duodenum is everted, or when a probe is carried through the biliary duct. These ducts sometimes open into the intestine separately. The biliary duct is slightly constricted near its orifice. After perforating the muscular coat, the two ducts run half an inch or more between it and the mucous membrane, before opening into the duodenum. When the intestine is inflated, air will not pass into these ducts on account of the mucous membrane being pressed against the muscular layer.

The Villi, Fig. 165, are small vascular eminences, which are found on the mucous surface of the whole of the small intestine. They vary from one-fifth to four-fifths of a line in length. They are most numerous in the duodenum and jejunum where the valvulæ conniventes are most prominent.

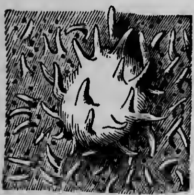
Some of them have a conical form, while others have a flattened or triangular shape. They give to the internal surface of the intestine a velvety appearance. They consist of projections of the mucous membrane, covered by epithelium, and contain a network of capillary vessels, and lacteals or absorbent vessels. They are very distinctly seen, when a portion of the intestine is minutely injected and allowed to float in water or alcohol.

The GLANDS, or FOLLICLES OF LIEBERKÜHN, are small crypts found in every part of the small intestine. They are situated between the villi and around the larger glands. They are similar to the small tubuli observed in the mucous membrane of the stomach.

The GLANDS OF BRUNNER are small glandular bodies, situated in the cellular coat of the duodenum, forming small projections on the surface of the mucous membrane. They are about the size of hemp seed. Each gland is composed of several lobules, which open on the mucous surface through a common duct. In structure they resemble the salivary glands.

The GLANDULÆ SOLITARIÆ, Fig. 165, are small projecting bodies, observed along the whole track of the small intestine. They are covered by villi, and surrounded by the crypts of Lieberkühn. They have no excretory ducts, or open mouths. When they are cut into they are found to contain a whitish, granular substance. Their use is not known.

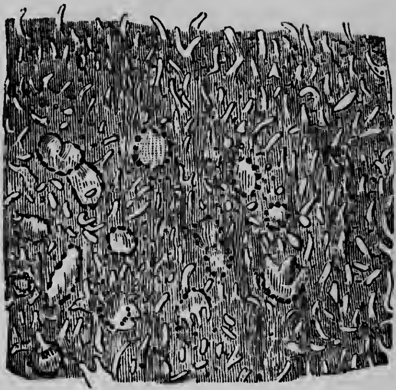
Fig. 165.



SOLITARY GLAND OF THE SMALL INTESTINE, MAGNIFIED. (Boehm.) The surface is beset with villi: the mouths of numerous crypts of Lieberkühn are also seen.

The GLANDS OF PEYER, Fig. 166, or the *glandulæ agminatæ*, are observed principally in the lower portion of the ileum, and on the side opposite to the attachment of the mesentery. They consist of patches varying in number from ten to thirty, or more, of an oval or oblong shape, being from one to two or three inches in length, and half an inch in breadth. They have no excretory ducts. Each patch is supposed to be an aggregation of the solitary glands, and, like them, their function has not been ascertained. To examine them, the intestine should be laid open

Fig. 166.



Enlarged View of a part of a Patch of Peyer's Glands. It shows the different forms of the individual vesicles, the zone of foramina belonging to Lieberkühn's follicles around each, the mouths of other of those follicles and numerous villi situated between the vesicles, not upon them, and, lastly, the surrounding darker part of the mucous membrane beset merely with villi and follicles.

along its concave or attached border, and the mucus being carefully washed off, should then be held before a strong light.

The Large Intestine.

The location and the relations of the large intestine, except the rectal portion, have been described. Its caliber is much larger than that of the small intestine. It is largest at its commencement, and gradually diminishes in size to the lower part of the rectum, where, just above the anus, a pouch or dilatation exists. The external appearance of the large is quite different from that of the small intestine. Instead of being smooth and cylindrical, it presents, except the rectum, a sacculated appearance, the pouches being arranged longitudinally in three series, and separated by the same number of smooth surfaces extending the whole length of the cæcum and colon.

To dissect the large intestine, it should be removed, as before mentioned, from the abdomen and inflated. As the rectum cannot be examined until the soft parts of the pelvis are dissected, it will be necessary to apply a ligature to the upper part of the rectum, and divide the intestine just above it. A small portion of the ileum should be removed with the cæcum and colon.

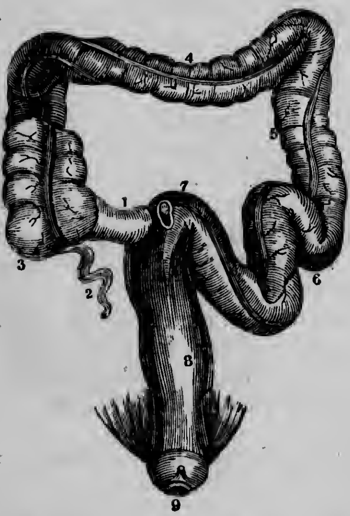
With the exception of the lower part of the rectum, the large intestine has the same number of layers in its parietes as the small.

A part of the transverse colon is placed between the two ascending layers of the omentum majus, and it consequently has, like the stomach, two non-peritoneal surfaces. The peritoneum on the cæcum and colon presents numerous small pouches filled with fat. The length of these is diminished when the bowel is inflated. They are called *appendices epiploicæ.*

The *longitudinal muscular fibres* in the cæcum and colon are collected into *three bands*, which correspond to the smooth surfaces between the pouches. They commence at the appendix vermiformis cæci, and terminate at the rectum. The sacculated form of the large intestine is caused by the relative shortness of these bands. The *circular fibres* are most numerous in the ridges which project into the intestine between the sacculi.

The *cellular coat* requires no special notice. It separates the mucous from the muscular coat in the same manner as the corresponding layer does in the small intestine.

Fig. 167.



A VIEW OF THE POSITION AND CURVATURES OF THE LARGE INTESTINE.—1. The end of the ileum. 2. Appendix vermiformis. 3. The cæcum, or caput coli. 4. The transverse colon. 5. The descending colon. 6. The sigmoid flexure. 7. Commencement of rectum. 8, 8. The rectum. 9. The anus. The levator ani muscle is seen on each side.

The *mucous coat* has a pale appearance. It has no folds corresponding to the valvulæ conniventes in the small intestine. The projections between the sacculi are formed of all the layers except the longitudinal fibres of the muscular coat. It has very few if any villi. It has *alveoli* similar to those observed in the stomach. It is everywhere thickly studded with the *orifices* of follicles or tubuli, which resemble those of Lieberkühn in the small intestine. There are also found scattered over its surface, *crypts* or *follicles*, of a large size. These consist of small pouches with contracted orifices, opening on the mucous surface. They are

more numerous in the cæcum and appendix vermiformis than elsewhere. These follicles may be inflamed without involving other parts of the mucous membrane.

The APPENDIX VERMIFORMIS CÆCI, Fig. 168 (5), has the same number of layers in its walls as the intestine. It opens into the cæcum by an orifice about the size of a goose-quill. Sometimes a valvular fold of mucous membrane is found situated at this opening. Foreign bodies sometimes pass into it, and give rise to inflammation and ulceration of its coats. It is not known to have any function.

The ILEO-CÆCAL VALVE, Fig. 168 (3), or the *valve of Bauhin*, is placed at the opening of the small into the large intestine. It consists of two folds of the mucous membrane, including areolar tissue and a layer of muscular fibres. The upper fold is sometimes called the *ileo-colic valve.* They project into the large intestine so as to form a slit between their free borders. This slit is placed transversely to the large intestine between the cæcum and colon, and looks more into the latter than into the former. A fold of mucous membrane is extended from each commissure for some distance on the inner surface of the intestine; they have been named the *frœna* of the valve. The lower fold, or *ileo-cæcal valve,* is somewhat larger than the ileo-colic. The shape of the aperture between the valves depend very much on the manner in which the peritoneum is reflected from the small to the large intestine.

Fig. 168.

A VIEW OF THE CÆCUM—AFTER IT HAS BEEN DISTENDED—DRIED AND LAID OPEN IN FRONT.—1. The ascending colon. 2. One of the cells of the colon. 3. The ileo-cæcal valve. 4. The opening into the appendix vermiformis cæci. 5. Appendix vermiformis cæci. 6. A section of the lower end of the ileum.

The mucous membrane of the ileum is continued to the free borders of the valves where that of the cæcum and colon com-

mences. In this respect these valves resemble the one between the stomach and duodenum. When these valves are closed the contents of the large intestine cannot pass into the small.

To obtain a good view of these valves and the opening between them, the student should inflate and dry the cæcum and a portion of the colon and ileum, and then cut away a part of the former.

The Dissection of the Liver.

To dissect and study the liver, it should be removed from the abdomen. To do this it will be necessary to divide the ligaments or folds of peritoneum which attach this organ to the diaphragm, and also to remove a portion of the ascending vena cava with it. Care should be observed not to injure the diaphragm in this dissection.

The liver presents, for examination, an upper anterior, and an inferior posterior surface, a posterior and an anterior border, and a right and left extremity.

It is the largest gland in the body. Its weight varies from two to five pounds. Both its weight and size, however, will depend much on the amount of blood contained in its vessels. Its size is also greatly modified by disease. In some instances it has been found to weigh from twenty-five to thirty pounds, while in others its weight did not exceed a pound. It has a reddish brown color; but in this respect it varies very much in different subjects, and especially when diseased. It is fragile, and easily broken when pressed between the thumb and finger. Owing to its brittleness, it is liable to be lacerated by blows inflicted on the abdomen.

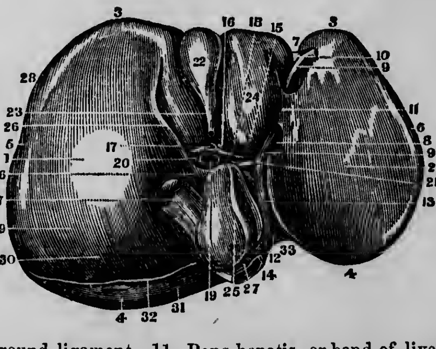
The *upper anterior surface* of the liver is convex, and moulded to the concavity of the diaphragm. The attachment of the suspensory ligament divides it into a right and left surface, corresponding to the right and left lobes.

The *posterior border* is rounded, thick at its right, and thin at its left extremity. The *anterior border* is thin, presenting quite a sharp edge. The *right extremity* is thick behind and thin anteriorly. The *left extremity* is thin. It will be observed that the posterior and right portion of the liver is the thickest part of it.

The *inferior posterior surface*, Fig. 169, is irregularly concave. It presents, usually, indentations for the right kidney, the colon, and the stomach. It has three fissures; two of which extend from the anterior to the posterior border. These last are named the *right and left antero-posterior fissures.* The left antero-posterior is sometimes called the *longitudinal fissure*, Fig. 169 (8). It indicates the line of division between the right and left lobes of the liver on its under surface. The remaining one connects these two, and is called the *transverse fissure*, Fig. 169 (15). The antero-posterior fissures are separated anteriorly by the *lobus quadratus*, Fig. 169 (24), and posteriorly by the *lobus Spigelii*, Fig. 169 (25), while the lobes themselves are separated from each other by the *transverse fissure.* The right antero-posterior fissure is interrupted just behind the transverse fissure, by a process extending from the lobus Spigelii to the under surface of the right lobe; this process is called the *lobus caudatus*, Fig. 169 (26).

The right antero-posterior fissure is occupied anteriorly by the *gall-bladder*, and posteriorly by the *vena cava.* The left antero-posterior fissure contains, anteriorly, the *remains*

Fig. 169.



The Inferior or Concave Surface of the Liver, showing its Subdivisions into Lobes. — 1. Centre of the right lobe. 2. Centre of the left lobe. 3. Its anterior, inferior, or thin margin. 4. Its posterior, thick, or diaphragmatic portion. 5. The right extremity. 6. The left extremity. 7. The notch on the anterior margin. 8. The umbilical or longitudinal fissure. 9. The round ligament or remains of the umbilical vein. 10. The portion of the suspensory ligament in connection with the round ligament 11. Pons hepatis, or band of liver across the umbilical fissure. 12. Posterior end of longitudinal fissure. 13, 14. Attachment of the obliterated ductus venosus to the ascending vena cava. 15. Transverse fissure. 16. Section of the hepatic duct. 17. Hepatic artery. 18. Its branches. 19. Vena portæ. 20. Its sinus, or division into right and left branches. 21. Fibrous remains of the ductus venosus. 22. Gall-bladder. 23. Its neck. 24. Lobus quadratus. 25. Lobus Spigelii. 26. Lobus caudatus. 27. Inferior vena cava. 28. Curvature of liver to fit the ascending colon. 29. Depression to fit the right kidney. 30. Posterior portion of its right concave surface over the renal capsule. 31. Portion of liver uncovered by the peritoneum. 32. Inferior edge of the coronary ligament in the liver. 33. Depression made by the vertebral column.

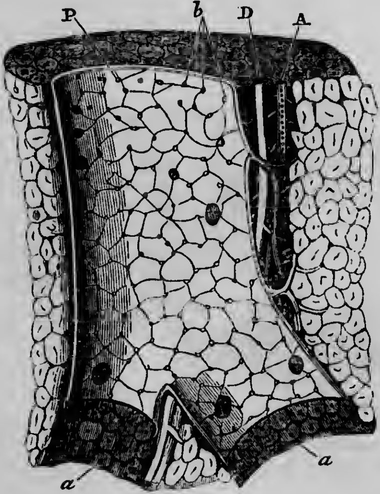
of the umbilical vein of the fœtus, and posteriorly, the *remains* of the *ductus venosus*. The transverse fissure is occupied by the *capsule of Glisson*, the *portal vein*, the *hepatic artery* and *duct*, the *hepatic plexus of nerves*, and the *deep absorbent vessels*.

The *pons hepatis*, Fig. 169 (11), when present, consists of a portion of the substance of the liver, extending across the left antero-posterior fissure beneath the ligamentum teres.

The *mouths of the hepatic veins* will be observed opening into the vena cava behind the lobus Spigelii, on the posterior border of the liver. There are usually three or four of these veins.

The *capsule of Glisson* is a dense areolar tissue which surrounds the vessels in the transverse fissure, and is prolonged into the substance of the liver, forming sheaths, named portal canals, Fig. 170, *a*, *a*, for these vessels; it also forms the proper capsule of the entire organ, as well as an investment

Fig. 170.



SECTION OF A PORTAL CANAL AND PORTAL VEIN LYING IN IT, IN COMPANY WITH THE HEPATIC ARTERY AND DUCT.—P. Branch of vena portæ, situated in *a*, *a*, a portal canal, formed amongst the lobules of the liver. The large orifices opening into the portal vein are the mouths of the vaginal branches. *b*. Orifices of interlobular veins, arising at once from the large vein. A. Hepatic artery. D. Hepatic duct.

for its lobules or acini. The inner surface of the portal canals is connected to the vessels by loose areolar tissue, while the external surface is closely connected to the sub-

stance of the liver by numerous prolongations sent off between the lobules.

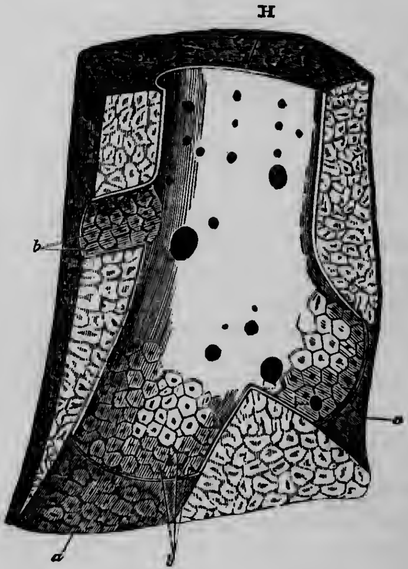
The student should trace the portal vein, the hepatic artery and duct, or, at least, their principal divisions, in the substance of the liver; also the hepatic veins.

The *vena portæ* enters the transverse fissure of the liver and divides into a right and left branch, forming at this division the *portal sinus.* The branches enter the liver, and divide and subdivide until every part of the organ is reached. The subdivisions of it are named, the *vaginal*, the *interlobular*, and the *lobular.*

The *hepatic artery* enters the liver with the vena portæ, and divides into the same number of branches as it. Its subdivisions are named the *vaginal*, the *interlobular*, and the *lobular.*

The *hepatic duct* accompanies the vein and artery in its

Fig. 171.



II. Longitudinal section of an hepatic vein. *a, a.* Portions of tho canal from which the vein has been removed. *b, b.* Orifices of intralobular veins. The large orifices opening into the hepatic vein are the mouths of the sublobular veins.

minute divisions, which have the same names. The spaces occupied by the portal vein, artery, and duct, are called the *portal canals.*

The *hepatic veins*, Fig. 171, H, commence in the lobules by the *intralobular veins*, which end in the *sublobular*, and these again terminate in the hepatic veins, of which there are, commonly, three or four principal trunks. These open into the vena cava near the diaphragm. They are not surrounded by areolar tissue like the portal vein, but adhere closely to the canals, the walls of which are very thin, and consequently do not collapse when they are divided.

A branch of an hepatic vein is readily distinguished from one of the portal vein; as the latter is always accompanied by a branch of the hepatic artery and duct, is surrounded by areolar tissue, collapses when divided, and is directed towards the transverse fissure. Neither the portal nor the hepatic veins have any valves.

The *nerves* and the *deep lymphatics* of the liver accompany the divisions of the hepatic artery and portal vein.

The proper substance of the liver consists of small granular polyhedral bodies named *lobules*. Each one is about the size of a millet seed, and represents, in miniature form, the entire liver. It is invested by a process from the capsule of Glisson, except at its base, where it rests on a sublobular vein.

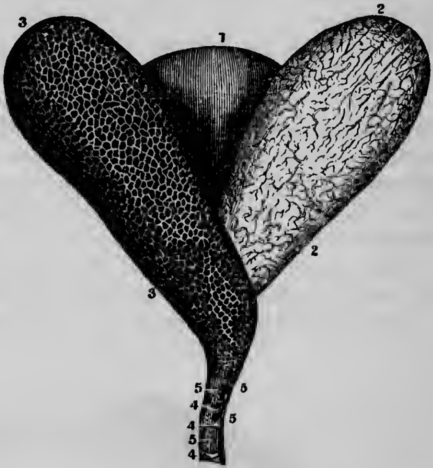
Dissection of the Gall-Bladder.

The *gall-bladder*, Fig. 169 (22), and Fig. 172, is attached to the under surface of the right lobe of the liver, and occupies the anterior portion of the right antero-posterior fissure. It is of a conical form. The *base* is directed downwards, forwards and to the right; sometimes it projects beyond the anterior border of the liver, and again does not extend to it. The *apex* is directed backwards, upwards, and to the left, where it ends in the cystic duct. It is subject to much variation in size.

Its free surface is covered by *peritoneum*, which is reflected from it to the liver. Its adherent surface is in contact with the substance of the liver, from which it is easily separated after the peritoneum has been divided around it. It has a *fibro-cellular coat*, which in some of the larger animals contains non-striated muscular fibres. The *mucous membrane* presents a honey-combed or reticulated appearance. It is stained with bile after death.

The neck of the gall-bladder is doubled twice upon itself. This is caused principally by the manner in which the peritoneum is attached to it. On the inside of the neck, Fig. 172

Fig. 172.



SHOWS THE THREE COATS OF THE GALL-BLADDER SEPARATED FROM EACH OTHER. —1. The external or peritoneal coat. 2, 2. The cellular coat with its vessels injected. 3, 3. The mucous coat covered with wrinkles. 4, 4. Valves formed by this coat in the neck of the gall-bladder. 5, 5. Orifices of the mucous follicles at this point.

(4, 4), the coats project inwards so as to form two or three folds, which resemble valves. They do not, however, interfere with the passage of the bile in either direction.

The *cystic duct*, Fig. 173, *f*, is about an inch and a half in length. It unites with the hepatic duct to form the ductus choledochus communis. Its inner surface presents from ten to fifteen semilunar projections, which not unfrequently have a spiral form, resembling the thread of a screw.

The *hepatic duct*, Fig. 173, *f*, is formed by the union of two trunks in the transverse fissure of the liver. It is about an inch and a half in length.

The *ductus choledochus*, Fig. 173, *f*, is formed by the cystic and the hepatic ducts. It is about two inches and a half long. It is lined by a mucous membrane, which is continuous on the one hand with the mucous membrane of the duodenum, and on the other with that of the cystic duct and the gall-bladder, and that of the hepatic duct and its numerous subdivisions in the liver. The fibrous layer of these ducts is regarded by some as being composed of the

non-striated muscular tissue. These ducts are partly covered by peritoneum.

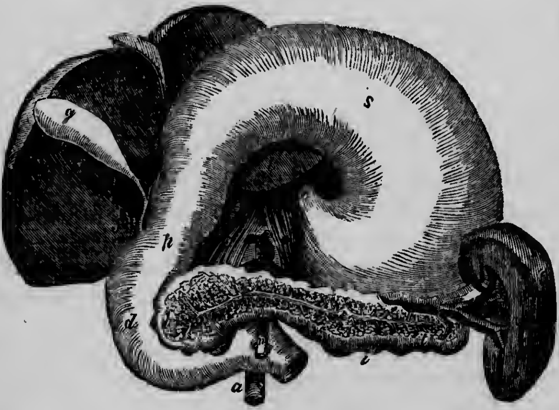
The gall-bladder is supplied with blood by the cystic branch of the hepatic artery, Fig. 155, *h*, and with nerves by offshoots from the hepatic plexus.

Dissection of the Pancreas.

The pancreas, Fig. 173 (*h*, *t*, *i*), is analogous to the salivary glands. It is from six to seven inches in length, and about three-fourths of an inch thick. Its breadth varies, its right extremity or the *head* being much broader than its left, which is called the *tail*. It has no proper fibrous capsule. In structure, it is similar to the parotid gland. It is composed of lobules, which are connected together by areolar tissue.

The *pancreatic duct*, Fig. 173 (*e*), extends the whole length

Fig. 173.



In this figure, which is altered from Tiedemann, the liver and stomach are turned up, to show the duodenum, the pancreas, and the spleen. *l.* The under surface of the liver. *g.* Gall-bladder. *f.* The common bile-duct, formed by the union of a duct from the gall-bladder, called the cystic duct, and of the hepatic duct coming from the liver. *o.* The cardiac end of the stomach, where the œsophagus enters. *s.* Under surface of the stomach. *p.* Pyloric end of stomach. *d.* Duodenum. *h.* Head of pancreas; *t*, tail; and *i*, body of that gland. The substance of the pancreas is removed in front, to show the pancreatic duct (*e*) and its branches. *r.* The spleen. *v.* The hilum, at which the bloodvessels enter. *c*, c. Crura of diaphragm. *n.* Superior mesenteric artery. *a.* Aorta.

of the pancreas. It has a very white appearance when exposed in the substance of the gland. Its parietes are thin like those of the excretory duct of the submaxillary gland. The branches by which it is formed join it nearly at right angles. It is situated a little nearer to the anterior than to the posterior surface of the pancreas, and nearer to the lower than to the upper border. Unlike other excretory ducts, it terminates almost immediately after leaving the gland. Sometimes there are two ducts, which may or may not open separately into the duodenum.

The *lesser pancreas* is merely the lower portion of the head. When there are two ducts, it is in this part of the gland that the second one is found.

The vessels and nerves of the pancreas have been described with the gland *in situ*.

Dissection of the Spleen.

The spleen, Fig. 173, *r*, occupies the deep part of the left hypochondrium. It has an oval form, being flattened and somewhat excavated on its inner side. It varies greatly in size. It has a deep red or purple color, especially when cut into. Its structure possesses but little firmness, and is easily broken up by pressure. It may be lacerated by blows on the external surface of the left hypochondriac region.

It presents a convex surface which looks towards the diaphragm and lower ribs, and a flat, slightly concave one, which is in apposition with the left extremity of the stomach. Its upper extremity is larger and more rounded than the inferior, and its posterior border is thicker than the anterior.

A *fissure*, or *hilum*, Fig. 173, *v*, is observed on its flat surface, being nearer to the posterior than to the anterior border. This fissure is occupied by the vessels and nerves of the gland.

The spleen has, besides the peritoneal, a *proper fibrous covering*, which not only invests the entire organ, but sends prolongations into every part of it, which, by interlacing, form a perfect network. It is also reflected in from the hilum around the vessels so as to form for them sheaths. It is elastic, quite strong, and may be said to form the framework of the organ. The cellular arrangement formed by this struc-

ture may be very well seen in a section of the spleen after repeatedly washing and squeezing it until the red pulpy substance, contained in the cells or interstices, has been removed. It will be observed that the processes sent in from the internal surface of the capsule are connected to the external surface of the sheaths of the vessels. The peritoneum adheres closely to the fibrous capsule.

The interstices are filled with a red pulpy granular substance. This, when exposed to the air, assumes a bright red color. Small vesicular bodies have been noticed in the granular substance.

The spleen is an exceedingly vascular organ, and its size depends much on the quantity of blood which it contains. It has no excretory duct. Sometimes one or more small bodies are found in the neighborhood of the spleen, which resemble it in color and structure.

Dissection of the Kidneys.

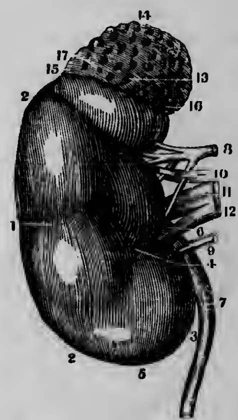
These are two organs for the secretion of the urine, situated, one in each lumbar region, Fig. 177 (1, 1). They are sometimes connected across the spine so as to form what is called the *horse-shoe* kidney. Sometimes one is entirely absent. They are usually smaller in the female than in the male. They are about four inches in length, two in breadth, and one in thickness. In shape they resemble the kidney bean. Their color is a deep brown-red.

Each kidney, Fig. 174, presents an anterior and posterior surface, an upper and a lower extremity, and an outer and inner border. The anterior surface is more convex than the posterior, and the upper extremity is broader and thicker than the lower. The external border is convex, while the internal is concave and marked by quite a *deep fissure* or *hilum*, which contains the renal vessels, nerves, and excretory duct. The excretory duct is usually situated in the lower and posterior part of the fissure or hilum, while the veins are placed in the front part, with the arteries immediately behind them.

The kidney has a *proper fibrous capsule* which invests the entire organ, and sends into its substance fine delicate pro-

cesses which are easily broken. It also joins the fibrous layer of the ureter, and is prolonged internally along with the vessels, as far as the *apices* or *papillæ*. It requires but little force to detach this membrane from the substance of the kidney.

Fig. 174.



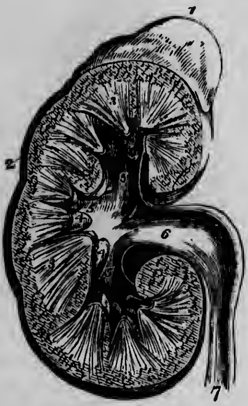
A VIEW OF THE RIGHT KIDNEY AND ITS SUPRA-RENAL CAPSULE.—1. Anterior face of the kidney. 2. External or convex edge. 3. Its internal edge. 4. Hilum. 5. Inferior extremity of the kidney. 6. Pelvis of the ureter. 7. Ureter. 8, 9. Superior and inferior branches of the emulgent artery. 10, 11, 12. The three branches of the emulgent vein. 13. Supra-renal capsule. 14. Its superior edge. 15. Its external edge. 16. Its internal extremity. 17. The fissure on the anterior face of the capsule.

In dissecting the kidney, the student should, in the first place, carefully remove the areolar tissue and fat from the hilum, so as to obtain a distinct view of the vessels and the ureter, Fig. 174 (7, 8, 11). Having done this, the ureter should be slit up on one side, cutting away at the same time a portion of the kidney. That part of the ureter situated in the hilum is named its *pelvis*, Fig. 175 (6). There will be observed opening into the pelvis three apertures, sometimes only two; these are called the *infundibula*, Fig. 175 (5, 5, 5). If one of these now be laid open, a cavity will be seen with several eminences or *papillæ* projecting into it. The cup-shaped depression which is observed surrounding each papilla is called the *calix*. Sometimes two papillæ are found projecting into a single calix. Small openings may be noticed on each papilla, which are the *mouths* of uriniferous tubes, and if the kidney be pressed between the thumb and finger, urine may frequently be seen escaping from them.

Each papilla is the *apex* of a *conical-shaped portion*, Fig. 175 (3, 3) of the kidney, which is composed of a great number of straight tubes. If the kidney be divided through one of the apices, the outlines of the cone to which the apex belongs will be distinctly seen, having a striated appearance, with its base imbedded in a different kind of structure. The *base* of each cone is rounded off, and reaches to within about two lines of the external surface of the kidney. There are from

ten to eighteen of these cones, forming about one-fourth part of the kidney. Each one is separate and distinct from the rest. They constitute what is called the *medullary* portions, while the remaining three-fourths is named the *cortical* or *vascular* substance, Fig. 175 (2). The urine is secreted in the latter, which is much more vascular than the former, as it requires blood not only for nourishment but to supply the elements of which the urine is formed. It is less firm and more easily broken up than the medullary substance, and is usually of a brighter red color.

Fig. 175.



A SECTION OF THE KIDNEY, SURMOUNTED BY THE SUPRA-RENAL CAPSULE; THE SWELLINGS ON THE SURFACE MARK THE ORIGINAL CONSTITUTION OF THE ORGAN OF DISTINCT LOBES.—1. The supra-renal capsule. 2. The vascular or cortical portion of the kidney. 3, 3. Its tubular portion, consisting of cones. 4, 4. Two of the papillæ projecting into their corresponding calices. 5, 5, 5. The three infundibula; the middle 5 is situated in the mouth of a calyx. 6. The pelvis. 7. The ureter.

When the two substances are examined with the microscope, they are both found to contain tubes. These commence, for the most part, by closed but dilated extremities in the cortical substance. They are at first very tortuous, but as they proceed to enter the base of a cone, they assume a straight direction. They are known in the cortical substance as the *convoluted tubes of Ferrein*, and in the cones as the *straight tubes*, or the *ducts of Bellini*. From the extent of surface on the base of each cone, it will readily be seen that the number of tubes which enter it must be very great, and, also, that the number, by the union which is constantly taking place, must be greatly diminished before they reach the apex of the cone. The tubes which converge to form by their junction one of the straight tubes, constitute a *pyramid of Ferrein*.

The *corpuscles of Malpighi*, in the cortical substance, consist of tufts of vessels contained in the dilated extremities, and in capsular dilatations on the sides of the tubes of Ferrein. Each capsule is perforated by an *afferent* and an *efferent* vessel. The former is an artery, and the latter a vein. After the vein leaves the

capsule it forms a plexus around the tube, and then terminates in a branch of the renal vein.

The URETERS convey the urine from the kidneys to the bladder. They are from sixteen to eighteen inches in length. Below its pelvis each one is about the size of a goose-quill. The manner in which it is formed in the hilum by the calices, the infundibula, and the pelvis, has been noticed in the dissection of the kidney. Its walls consist of two layers, a *fibrous* and a *mucous.* The fibrous layer is said to contain muscular fibres, and is very dilatable. The mucous membrane is continuous above with the lining membrane of the uriniferous tubes, and below with that of the bladder. The manner in which the ureter perforates the coats of the bladder will be noticed in the dissection of that organ.

Fig. 176.

PLAN OF THE RENAL CIRCULATION; COPIED FROM MR. BOWMAN'S PAPER. — *a.* A branch of the renal artery giving off several Malpighian twigs. 1. An afferent twig to the capillary tuft contained in the Malpighian body, *m;* from tho Malpighian body the uriniferous tube is seen taking its tortuous course to *t.* 2, 2. Efferent veins; that which proceeds from the Malpighian body is seen to be smaller than the corresponding artery. *p, p.* The capillary venous plexus, ramifying upon the uriniferous tube. This plexus receives its blood from the efferent veins, 2, 2, and transmits it to the branch of the renal vein, *v.*

The SUPRA-RENAL CAPSULE, Fig. 175 (1), is a small body of a crescentic form, situated on the upper end of each kidney. The one on the right side is placed between the kidney and the liver, resting on the diaphragm, and having the vena cava and the duodenum in front of it. The left one also rests on the diaphragm, and has the spleen and pancreas above and in front of it. They are moulded on the upper extremities of the kidneys, to which they are attached by loose areolar tissue. Without some care they might be readily confounded with the fat which surrounds them.

They are yellowish externally, and when cut into present a striated lamina or cortical substance of the same color, and a dark-colored medullary substance, of a much softer consistence. Occasionally they are found to contain a small cavity in the centre. They have no excretory ducts,

and their use is not known. They are usually classed with the thymus and thyroid bodies, and are supposed to perform some function connected with fœtal life. In the fœtus they are nearly as large as the kidneys. They are well supplied with bloodvessels.

The abdominal viscera having been removed and examined, the student may now proceed to dissect the vena cava and the aorta, with such of their branches as have not already been noticed. The thoracic duct, the sympathetic cord, the branches of the lumbar plexus of nerves, and some of the deep muscles will also be included in this dissection.

The AORTA, Fig. 177 (7), will be seen entering the cavity of the abdomen between the crura of the diaphragm, where it rests on the bodies of the last two dorsal vertebræ. It extends down to the fourth lumbar vertebra, where it divides into the *common iliacs.* It is placed somewhat on the left side of the bodies of the vertebræ over which it passes. The parts placed *in front* of it have been, for the most part, removed, or have already been examined. They are, the liver, the stomach, the pancreas, the solar plexus, the vena portæ, the lower portion of the duodenum, the transverse colon, the transverse mesocolon, the small intestines, the mesentery, the aortic plexus, and the left renal vein. The vena cava ascendens, the thoracic duct, the vena azygos, and the right semilunar ganglion lie on its *right* side. On its *left* side are the left semilunar ganglion, the left supra-renal capsule, and the peritoneum, which covers the lower part of it, both in front and on the left side. The left lumbar veins pass *behind* it.

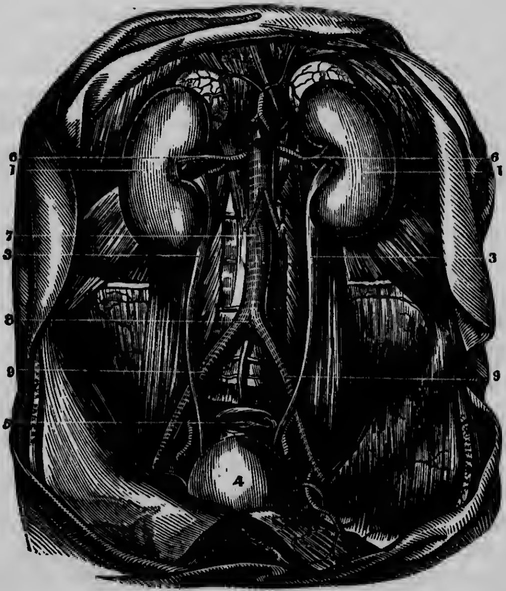
The PHRENIC ARTERIES, Fig. 177, and Fig. 159 (1), arise from the aorta separately or in common, near the cœliac. The *left* one passes upwards and outwards behind the œsophagus, to ramify on the under surface of the left portion of the diaphragm. The *right* one passes behind the vena cava, and is distributed to the under surface of the right portion of the diaphragm. They anastomose with each other, and with branches of the internal mammary and intercostal arteries. They do not always, or both of them at least, arise from the aorta.

The *lumbar arteries*, Fig. 159 (8), and Fig. 177, consist of four or five pairs. They correspond to the intercostal arteries. They arise from the posterior aspect of the aorta, and pass

outwards on the bodies of the vertebræ. The upper two on each side go behind the crus of the diaphragm and the lower two or three behind the psoas magnus. Each divides into an *abdominal* and a *dorsal branch.* The latter, after sending a branch through the intervertebral foramen to the spinal canal, goes to the muscles and integument of the back. The former pass behind the quadratus lumborum, and supply branches to the posterior abdominal parietes. They anastomose with the intercostal, the internal circumflex ilii, and the ilio-lumbar arteries. These arteries may be dissected on one side, leaving the psoas magnus and the nerves to be examined on the other; or they may all be dissected at the same time.

The *middle sacral artery*, Fig. 159 (12), arises from the posterior part of the aorta, just above its bifurcation. It is

Fig. 177.



A VIEW OF THE URINARY ORGANS IN SITU.—1, 1. The kidneys. 2, 2. The capsulæ renales. 3, 3. The ureters in their course to the bladder, and their relations to the bloodvessels. 4. Bladder distended with urine. 5. The rectum. 6, 6. The emulgent arteries. 7. The abdominal aorta. 8. Its division into the iliacs. 9, 9. The primitive iliacs at the points where the ureters cross them.

directed downwards on the sacrum into the pelvis. It may be traced a short distance in this stage of the dissection, but it cannot be followed out in its distribution until the pelvis is dissected.

The COMMON ILIAC ARTERIES, Fig. 177 (8), arise from the bifurcation of the aorta, and are directed downwards and outwards to the sacro-iliac symphyses. Each is from an inch and a half to two inches in length. The peritoneum and filaments of the sympathetic nerve, and sometimes the ureter, lie in front of it. The right one is usually somewhat longer than the left, on account of the aorta being placed to the left side. They diverge more in the female than in the male. Opposite to the sacro-iliac symphysis each divides into the external and internal iliac.

The EXTERNAL ILIAC ARTERY, Fig. 177, on each side is directed downwards and outwards along the brim of the pelvis to Poupart's ligament. It is covered by peritoneum through its whole extent. The ureter generally crosses it near its origin, and just above Poupart's ligament the vas deferens passes over it from without inwards. The psoas magnus lies at first on the outside of it, and then behind it. The external iliac vein is placed on the inner side of it, except on the right side where it passes under the artery near its origin. Just before it passes beneath Poupart's ligament it gives off the epigastric and the internal circumflex ilii arteries, which have been described with the abdominal parietes. The *obturator artery* sometimes has its origin from the external iliac.

The dissection of the internal iliac artery must be postponed for the present.

The VENA CAVA ASCENDENS commences below, opposite the last lumbar vertebra. It is formed by the union of the common iliac veins. It ascends, on the right side of the aorta, to the cordiform tendon of the diaphragm, which it perforates, to join the right auricle of the heart. In its course it receives the lumbar, the right spermatic or ovarian, the renal, the supra-renal, the phrenic, and the hepatic veins. The lumbar and the phrenic veins accompany their corresponding arteries, and require no particular description. The other veins have been noticed. The vena cava has no valves. The *external iliac veins* were observed in the dissection of their corresponding arteries.

The COMMON ILIAC VEINS correspond to the common iliac arteries. The *left* one is longer and more oblique than the *right*. It lies at first on the inner side of the left common iliac artery, and then passes under the right common iliac, to join the right common iliac vein, which is placed on the outer side of its accompanying artery. The middle sacral vein opens into the left common iliac. The common iliac veins are formed by the junction of the external and internal iliacs.

The CORD AND THE LUMBAR GANGLIA of the sympathetic nerve, Fig. 142 (17), are situated on the bodies of the lumbar vertebræ. There are usually three or four ganglia on each side. The cord enters the abdomen on each side beneath the inner arch of the diaphragm, or the true ligamentum arcuatum, continues down along the internal border of the psoas magnus muscle, and descends into the pelvis beneath the common iliac artery. From the ganglia external and internal branches are given off. The *external* branches pass beneath the psoas muscle, and join the lumbar nerves. The *internal* are directed inwards, and form, with filaments from the solar plexus, the *aortic plexus*. Other branches go to join the plexuses which supply the viscera.

The *aortic plexus* terminates in filaments which accompany the iliac arteries, and in others which join the hypogastric plexus in front of the sacrum.

The *hypogastric plexus* is formed by filaments from the aortic plexus, and from the lumbar and sacral ganglia. Those from the lumbar ganglia reach it by passing over the common iliac arteries. It divides into other plexuses which accompany the arteries that go to the pelvic viscera.

The LUMBAR NERVES, Fig. 178, consist of five pairs. They divide, after leaving the intervertebral foramina, into anterior and posterior branches. The *latter* are distributed to the muscles and the integument of the back. The *anterior* branches are much the largest. They enter the psoas muscle, where they divide and unite again with each other, so as to form the lumbar plexus. The first one is connected to the last dorsal, and the last two to the sacral nerves.

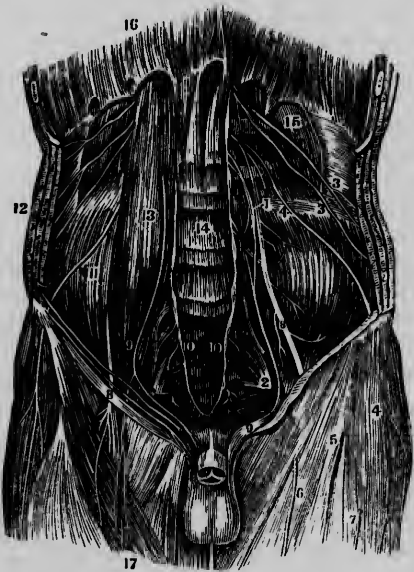
The LUMBAR PLEXUS, Fig. 178 (1), is larger below than above. It is placed at the sides of the lumbar vertebræ, and in the posterior part of the psoas muscle. It gives off the

following nerves: The superior musculo-cutaneous or ilio-scrotal, the middle musculo-cutaneous, the inferior musculo-cutaneous or external cutaneous, the genito-crural, the anterior crural, and the obturator. The superior and middle musculo-cutaneous have been described with the abdominal parietes.

The INFERIOR MUSCULO-CUTANEOUS, or EXTERNAL CUTANEOUS BRANCH, Fig. 178 (4), usually arises from the second lumbar nerve, leaves the psoas muscle, and passes over the iliacus internus to Poupart's ligament, near the anterior superior spinous process of the ilium. It goes under the ligament and supplies the integument on the outer part of the thigh. It is bound down by fascia in the iliac fossa.

The GENITO-CRURAL NERVE, Fig. 178 (9), arises from the

Fig. 178.



A VIEW OF THE LUMBAR AND SACRAL PLEXUSES AND THE BRANCHES OF THE FORMER.—1. The lumbar plexus. 2. The sacral plexus. 3, 3. Superior and middle musculo-cutaneous nerves. 4. Inferior musculo-cutaneous nerve. 5, 6, 7. Cutaneous branches from 8. The anterior crural nerve. 9. The genito-crural nerve. 10, 10. The lower termination of the great sympathetic. 11. The iliacus internus muscle. 12. The three broad muscles of the abdomen. 13. The psoas magnus muscle. 14. The bodies of the lumbar vertebræ. 15. The quadratus lumborum muscle. 16. The diaphragm. 17. The sartorius.

second and third lumbar, pierces the psoas muscle, and descends on its anterior surface, to divide into its genital and crural branches. The division may take place in the muscle. The *genital branch* enters the inguinal canal, and joins the spermatic cord, but does not form a part of it. It is distributed to the scrotum, in the male, or the external labia in the female. The *crural branch* passes through the crural ring, and is lost on the anterior part of the thigh.

The ANTERIOR CRURAL NERVE, Fig. 178 (8), arises principally from the third and fourth lumbar. It pierces the psoas muscle, and gets in the groove between it and the iliacus internus. It passes beneath Poupart's ligament, about half an inch to the outer side of the femoral artery. It sends small branches to the psoas and iliacus internus muscles.

The OBTURATOR NERVE arises from the third and fourth lumbar, and passes downwards on the inner side of the psoas muscle, and behind the external iliac vessels to the opening in the upper part of the obturator ligament. It is distributed to the muscles and integument on the inner part of the thigh. It also sends filaments to the hip-joint. Sometimes there is an *accessory obturator nerve* which arises from the third and fourth lumbar, and descends on the inner side of the psoas to the pubic bone, over which it passes to the thigh. It sends filaments to the pectineus and adductor brevis, to the hip-joint, and others to unite with the obturator nerve.

A fasciculus from the fourth and the whole of the fifth lumbar nerve descends into the pelvis to join the sacral plexus and to form the superior gluteal nerve. It is named the *lumbo-sacral nerve.*

The RECEPTACULUM CHYLI, Fig. 141 (12), or the commencement of the thoracic duct, should be sought by the student. It is placed in front of the second lumbar vertebra, and between the right crus of the diaphragm and the aorta. The vena azygos is situated on the right side of it. It requires a little care to distinguish it from the areolar tissue around it. It is formed by the union of three or four lymphatic trunks.

The ILIAC FASCIA should be examined before the iliacus and psoas muscles are dissected. It is attached to the outer

two-thirds of Poupart's ligament, where it is continuous with the fascia transversalis, to the whole of the inner border of the crest of the ilium, to the ligamentum arcuatum externum, to the bodies of the lumbar vertebræ, and to the brim of the pelvis. The lower part is thicker and more aponeurotic than the upper and inner part. It covers the psoas and iliacus internus muscles. The external iliac artery and vein lie in front of it. Where these vessels pass beneath Poupart's ligament, a process of the iliac fascia is prolonged down behind them, which, joined to a similar prolongation of the fascia transversalis in front of the vessels, forms a *funnel-shaped sheath* around them. This will be noticed more particularly in the dissection of the parts concerned in femoral hernia.

It will be observed, from the attachment of the iliac fascia, that when pus collects beneath it, it will have a tendency to follow the psoas and iliacus muscles to the upper and anterior part of the thigh.

The PSOAS MAGNUS, Fig. 178 (13), *arises* from the margins of the bodies of the lower two dorsal and the upper four lumbar vertebræ, from the intervertebral substance, from the ligamentous bands which arch over the grooves on the sides of the bodies of the vertebræ, and from the bases of the transverse processes. The fibres proceed downwards and somewhat outwards along the brim of the pelvis, beneath Poupart's ligament, and end in a tendon which passes backwards and inwards over the capsular ligament of the hip-joint, and is *inserted* into the posterior part of the small trochanter. A *bursa* is placed between its tendon and the pubic bone and the capsular ligament. There is also a *small bursa* between it and the trochanter. The lumbar arteries and the nerves of communication between the lumbar and the sympathetic pass in the grooves on the bodies of the vertebræ, beneath the tendinous arches from which this muscle in part arises. The action of the psoas is to flex the thigh on the pelvis, or the body on the thigh. From the position of the trochanter minor this muscle rotates the thigh outwards before flexing it on the body.

The PSOAS PARVUS is frequently wanting. When present, it is situated mainly in front of the psoas magnus. It *arises* from the bodies of the last dorsal and the first lumbar ver-

tebræ, and from the intervertebral substance between them. The fibres pass downwards, and terminate in a thin flat tendon, which is *inserted* into the brim of the pelvis and into the iliac fascia. As it descends it crosses the psoas magnus from without inwards. Its action is to render the iliac fascia tense, and, through it, Poupart's ligament. It may also assist in flexing the pelvis on the spine.

The Iliacus Internus, Fig. 178 (11), *arises* from the whole of the iliac fossa, from the ilio-lumbar ligament, from the anterior spinous processes of the ilium and the notch between them, and from the capsular ligament of the hip-joint. The fibres converge and pass downwards and inwards to end in the tendon of the psoas magnus with which it is *inserted* into the trochanter minor. A portion of its fibres are inserted directly into the shaft of the femur just below the trochanter. Its action is similar to that of the psoas magnus. These muscles are concerned in walking; as, in raising and moving the lower extremity forwards. When they act on both sides and the thighs are fixed, they bend the body forwards.

The Diaphragm, Fig. 179, forms a muscular septum between the thoracic and abdominal cavities. Its upper surface is covered by the pleuræ and the pericardium, and is in relation with the thoracic viscera; its lower surface is principally covered by the peritoneum, and is in relation with the viscera of the abdomen. The peritoneum is easily removed by dissecting and peeling it off before the cavity of the thorax is opened, as the muscle is then tense. It is usually described as consisting of a greater and a lesser muscle, which are connected by a central tendon.

The *greater muscle*, Fig. 179 (1, 2, 3), forms the anterior and lateral portions; the *lesser muscle*, Fig. 179 (8, 10), forms the posterior part. The first *arises* from the ensiform cartilage, the last true and all the false ribs, and from the ligamenta arcuata, externum and internum. Its origin from the ensiform cartilage consists of one or two fasciculi, with a small triangular space on each side, in which the anterior mediastinal space is separated from the abdomen only by peritoneum. Viscera of the abdomen may be forced through these spaces into the thorax, producing *diaphragmatic hernia;* or pus may escape from the mediastinum through them into

the abdomen. Its costal attachments form indigitations with the transversalis muscles.

Fig. 179.

THE UNDER OR ABDOMINAL SIDE OF THE DIAPHRAGM.—1, 2, 3. The greater muscle; the figure 1 rests upon the central leaflet of the tendinous centre; the number 2 on the left or smallest leaflet; and number 3 on the right leaflet. 4. The thin fasciculus which arises from the ensiform cartilage; a small triangular space is left on either side of this fasciculus, which is closed only by the serous membranes of the abdomen and chest. 5. The ligamentum arcuatum externum of the left side. 6. The ligamentum arcuatum internum. 7. A small arched opening occasionally found, through which the lesser splanchnic nerve passes. 8. The right or larger tendon of the lesser muscle; a muscular fasciculus from this tendon curves to the left side of the greater muscle between the œsophageal and aortic openings. 9. The fourth lumbar vertebra. 10. The left or shorter tendon of the lesser muscle. 11. The aortic opening occupied by the aorta, which is cut short off. 12. A portion of the œsophagus issuing through the œsophageal opening. 13. The opening for the inferior vena cava, in the tendinous centre of the diaphragm. 14. The psoas magnus muscle passing beneath the ligamentum arcuatum internum; it has been removed on the opposite side to show the arch more distinctly. 15. The quadratus lumborum passing beneath the ligamentum arcuatum externum; this muscle has also been removed on the left side.

The fibres converge from this extended origin, and are *inserted* into the anterior and lateral borders of the central tendon.

The *lesser muscle arises*, tendinous, on the right side from the bodies of the upper three or four lumbar vertebræ, and from their intervertebral substance; and on the left side from the

first two or three vertebræ. These portions are named *the crura*, or *pillars* of the diaphragm. They pass upwards and forwards, and at a short distance in front of the last dorsal vertebra are united by a fibrous band, which forms an arch over the aortic opening. Above this point they become muscular, and by a decussation of their inner fasciculi, partly form the œsophageal opening, and separate it from the aortic. They spread out, and finally *end* in the posterior part of the central tendon.

The *central* or *cordiform tendon* is composed of three parts, called *leaflets*, or *alæ*, Fig. 179 (1, 2, 3). The middle and anterior one is usually the largest. It corresponds to the pericardium. The left one is the smallest, and is below the left lung. The fibres of this tendon interlace with each other, and are also crossed in different directions by accessory fibres.

There are three principal *foramina* in the diaphragm.

The *hiatus aorticus*, Fig. 179 (11), is situated in front of the body of the last dorsal vertebra, and between the crura. It transmits the aorta, and sometimes one of the great splanchnic nerves.

The *œsophageal opening*, Fig. 179 (12), is placed directly behind the cordiform tendon, which sometimes forms a part of its anterior boundary. It is to the left, and in front of the aortic opening. The *decussating fasciculi* of the crura form its posterior and lateral boundaries. It has been supposed that these fasciculi might act as a sort of sphincter muscle to the œsophagus, as it passes through this opening. The œsophagus and the pneumogastric nerves pass through it. The aortic and œsophageal foramina lead from the cavity of the abdomen into the posterior mediastinum.

The *foramen quadratum*, Fig. 179 (13), is situated to the right side of the median line, and considerably anterior to either of the others. It is placed in the posterior part of the right leaflet, and is wholly surrounded by tendinous fibres; thus the vena cava is not liable to be compressed by the action of the diaphragm. It transmits the ascending cava and a few filaments of the phrenic nerve.

The sympathetic, and the greater and lesser splanchnic nerves, and also the left azygos vein, pass through small foramina in the diaphragm.

The diaphragm is a muscle of inspiration. When it acts,

the lateral muscular portions descend, and the fibres assume nearly a horizontal direction. It also assists the muscles of the abdomen in compressing the abdominal viscera, &c. The cordiform tendon is subject to but very little movement.

The LIGAMENTUM ARCUATUM EXTERNUM, Fig. 179 (5), extends from the transverse process of the first lumbar vertebra to the last rib. It forms a fibrous arch over the quadratus lumborum muscle. It is the upper border of the anterior lamina of the fascia lumborum.

The LIGAMENTUM ARCUATUM INTERNUM, Fig. 179 (6), passes from the body of the second lumbar vertebra to the transverse process of the first. It forms a fibrous arch over the psoas magnus and the sympathetic nerve.

SECT. III.—DISSECTION OF THE PELVIC VISCERA.

THE RECTUM.

The RECTUM, Fig. 167 (8), is the last portion of the alimentary canal. It occupies the posterior part of the pelvic cavity, and extends from the sigmoid flexure of the colon to the anus. In an antero-posterior direction it presents only a single curvature, which corresponds to that formed by the sacrum and os coccygis, until it reaches the lower part of the coccyx, where it is inclined a little backwards. The upper part of it is directed, laterally, from a point opposite the left sacro-iliac junction to the median line in the lower part of the hollow of the sacrum.

It is from six to eight inches in length. It is cylindrical, but not sacculated, like the colon. The upper part of it is somewhat constricted, but the lower part, to within a short distance of the anus, is expanded into a pouch-like dilatation, below which it is again contracted.

The rectum has the same number of layers in its walls as the other divisions of the intestinal canal, except the lower third, which has no serous covering. The muscular coat is much thicker than that of the colon or small intestine, resembling in this respect the œsophagus.

The *longitudinal fibres* are not arranged in bands as they are in the colon, but are distributed equally on all sides, as

in the small intestine. Some of them terminate in the external sphincter of the anus; others are reflected inwards and upwards around the internal sphincter, and are lost in the submucous areolar tissue from half an inch to an inch above the anus.

The *circular fibres* are collected into quite a large fasciculus at the lower end of the rectum, forming what is called the *internal sphincter* of the anus.

The *mucous membrane* of the rectum presents a number of large irregular folds, which are not wholly obliterated when the bowel is distended. At the lower end of the bowel there are several small longitudinal folds, between which depressions exist, and in which foreign substances are sometimes lodged. The mucous membrane in the lower part of the rectum is very loosely connected to the muscular layer. Hence prolapsus of it sometimes occurs.

The *arteries* of the rectum are the superior, the middle, and the inferior *hemorrhoidal*. The *superior* are branches of the inferior mesenteric; the *middle*, of the internal iliac; and the *inferior*, of the internal pudic. The rectum is more vascular than any other portion of the large intestine.

The *veins* are named the superior, middle, and inferior *hemorrhoidal*. A *plexus* of veins is found beneath the mucous membrane in the lower part of the rectum, which, by becoming varicose, forms hemorrhoids. This plexus communicates with the *vesical plexus*. The hemorrhoidal veins empty partly into the inferior mesenteric, and partly into the internal iliac.

The *nerves* of the rectum are derived from the sympathetic system, and from the sacral plexus.

Dissection of the Bladder.

The Bladder should be examined *in sitû*, when distended as well as when empty, in order to understand its relations to the surrounding parts in both of these conditions. To study its structure, it should be removed from the pelvis together with the prostate gland and the penis. It varies greatly in size in different individuals, and under different circumstances. It is said to be larger and more globular in the female than in the male.

Its parietes are composed of a serous, a muscular, a cellular, and a mucous layer.

The SEROUS LAYER is found only on the upper, posterior, and lateral portions. The anterior surface has no serous investment, nor have the sides anteriorly; and the same is true of the lower part posteriorly, especially when the bladder is distended. The serous layer is loosely connected to the one beneath it by areolar tissue.

The MUSCULAR LAYER, Fig. 186, consists of three sets of fibres or fasciculi, a longitudinal, a circular, and a reticular. To examine the muscular structure of the bladder, it should be distended with air or some suitable material, as hair or tow.

The *longitudinal fibres* are placed on the outside. They are spread out over the entire organ, and terminate below at the neck of the bladder; some of them are inserted into the cervix, others enter the substance of the prostate gland, and a few are attached to the anterior ligament of the bladder and through it to the pubic bone.

The *circular fibres* are thinly scattered over the body of the bladder, but increase in number towards the cervix, where they form what has been regarded by some as the *sphincter vesicæ.*

The *reticular fibres* are very irregular in their distribution. They cross each other in different directions, and give to the interior of the bladder a reticulated appearance. Sometimes these fasciculi become so large that quite deep crevices are found between them, into which the mucous membrane is reflected, forming pouches in which calculi are sometimes lodged. When these pouches exist, the bladder is said to be sacculated.

The CELLULAR LAYER is placed between the muscular and mucous, and requires no particular description.

To examine the MUCOUS LAYER, Fig. 180, and the internal appearance of the bladder, it should be laid open along the median line in front. The mucous membrane is thin, soft, and of a pale color, and presents numerous folds, most of which are transverse. These rugæ, however, disappear when the bladder is filled. Mucous follicles may be seen, especially in the neighborhood of the cervix. The orifices of the ureters and of the urethra, with the triangular space

called the trigone, will be observed in the lower and posterior part of the bladder.

The *trigone*, or *vesical triangle*, Fig. 180 (7), is the small space between the three orifices of the bladder. The rugæ, which are seen in other parts of the bladder, are here absent, the surface being smooth, with the exception of some fine striæ, which are directed towards the orifice of the urethra.

The *orifices* of the ureters, Fig. 180 (3, 3), which appear like small slits in the mucous membrane, are situated at the posterior angles of the trigone. The distance between them varies according as the bladder has been contracted or distended. A probe should be passed through the orifice of one of the ureters, to show the oblique manner in which it perforates the coats of the bladder. It will be found to traverse three-fourths of an inch or more of the cellular layer after perforating the muscular coat. This arrangement prevents the contents of the bladder, even when it is filled with air, from passing into the ureters.

Fig. 180.

The Bladder and Urethra of a Man laid open in its whole Length.—1, 1. The bladder cut open by a crucial incision, and the four flaps separated. 2, 2. The ureters. 3, 3. Their vesical orifices. 4. Uvula vesicæ. The triangle formed by the points at 3, 3, 4, is the vesical triangle. 5. Superior fundus of the bladder. 6. Bas fond of the bladder. 7. The smooth centre of the vesical triangle. 8. Verumontanum, or caput gallinaginis. 9. Orifice of the ductus ejaculatorius. 10. Depression near the verumontanum. 11. Ducts from the prostate gland. 12, 13. Lateral lobes of the prostate gland. 14. Prostatic portion of the urethra; just above is the neck of the bladder. 15. Membranous portion of the urethra. 16. One of Cowper's glands. 17. The orifices of their excretory ducts. 18, 18. Section of the bulb of the urethra with its erectile tissue. 19, 19. Cut edges of the corpora cavernosa. 20. Cut edges of the glans penis. 21. Prepuce dissected off. 22. Internal surface of the urethra laid open. 23, 23. Outer surfaces of corpora cavernosa. 24, 25. Accelerator urinæ muscles. 26, 27. Erector penis muscles. 28, 29. Vasa deferentia.

The *uvula vesicæ*, Fig. 180 (4), is a slight elevation seen at the apex of the trigone, and near the orifice of the urethra. It is formed by a thickening of the submucous areolar tissue, and corresponds to the third lobe of the prostate gland.

If the mucous membrane of the trigone be dissected off, a strong fasciculus of muscular fibres will be found situated at its base, extending between the orifices of the ureters; and also a fasciculus going from the orifice of each of the ureters to the uvula. The last have been called the *muscles of the ureters*, or *the muscles of Bell*, as they were described by him. A layer of dense, white fibrous tissue is found immediately beneath the mucous membrane in the trigone. It is on account of this structure, to which the mucous membrane is closely adherent, that no rugæ or folds are found in this part of the bladder.

The *Neck* of the bladder, although its limits are not defined by any natural lines of demarcation, may be considered as that part which is applied to the base of the prostate gland. It is surrounded above and laterally, on the outside of the mucous membrane, by a fibro-muscular tissue, which is supposed to act as a *sphincter muscle*. Many of the longitudinal fibres of the bladder are inserted into this structure.

Dissection of the Prostate Gland.

The Prostate Gland, Fig. 181 (7), surrounds the neck of the bladder and the upper portion of the urethra. It is of a conical shape, with its base applied to the bladder. Its transverse diameter is about an inch and a half, its antero-posterior an inch and a quarter, and its vertical from three-fourths of an inch to an inch. The antero-posterior diameter is in the direction of the urethra. Its relations to the surrounding parts are described with the pelvic viscera *in sitû*. The urethra passes through the upper part of it, having only about one-third of the gland above it; it varies, however, a great deal in this respect. It consists of *three lobes*, two lateral and a middle. The latter is quite small; it is placed behind and between the other two, and is partly separated from them by a notch which is occupied by the *common ejaculatory ducts*. The uvula vesicæ is situated directly above it.

The prostate is composed of numerous *granules*, which are

arranged so as to form *lobules*. These are compressed closely together, so that the gland has quite a dense, solid feel. It is traversed by muscular fibres, which come from the bladder. Its ducts, varying from ten to fifteen in number, open into the urethra on each side of the *caput gallinaginis*. Small calculi sometimes lodge in the mouths of these ducts.

The Urethra.

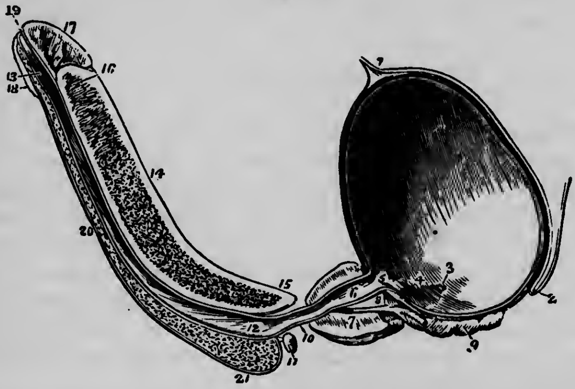
The Urethra is from seven to nine or ten inches in length, extending from the bladder to the end of the penis. It is composed of a mucous membrane, supported by a layer of areolar tissue, in which is observed longitudinal bands, supposed by some to be muscular, and by others fibrous. It is divided into three parts, each of which requires special notice, not only on account of its peculiar appearance, but on account of its relations to contiguous parts. The three divisions are named the prostatic, the membranous, and the spongy. In specifying the relative length of these divisions, the urethra will be supposed to be nine inches long.

The Prostatic Portion, Fig. 180 (14), is an inch and a quarter in length. It is shaped like a wine-cask, being larger in the middle than at the extremities. At the bottom of it in the median line is a prominence named the *caput gallinaginis*, or *verumontanum*, Fig. 180 (8). On the summit of this and near the middle, is the *sinus pocularis*, or *utricle*, which extends a short distance downwards and backwards in the direction of the common ejaculatory ducts which not unfrequently open into it. On each side of the verumontanum is a depression, named the *prostatic sinus*, Fig. 180 (11). The *ducts* of the prostate gland open into these sinuses, except those of the middle lobe, which open just behind and above the verumontanum. This portion of the urethra is surrounded by the prostate gland, and by the muscular coat of the bladder, which is prolonged downwards immediately around the urethra as well as into the substance of the gland.

The Membranous Portion, Fig. 180 (15), and Fig. 181 (10), is about three-fourths of an inch in length. It extends from the prostatic to the spongy portion. It passes through the triangular ligament, which fixes it firmly in its position. It is

covered by an erectile elastic tissue, by the muscles of Wilson and Guthrie, and by a layer of the deep perineal fascia. The caliber of its anterior extremity is smaller than that of any other part of the urethra, except the external orifice.

Fig. 181.



A Longitudinal Section of the Bladder, Prostate Gland, and Penis, showing the Urethra.—1. The urachus. 2. The recto-vesical fold of peritoneum. 3. The opening of the right ureter. 4. A slight ridge, formed by the muscle of the ureter. 5. The commencement of the urethra: the elevation of mucous membrane immediately below the number is the uvula vesicæ. 6. The prostatic portion of the urethra. 7. The prostate gland. 8. The isthmus, or third lobe of the prostate; immediately beneath which the ejaculatory duct is seen passing. 9. The right vesicula seminalis. 10. The membranous portion of the urethra. 11. Cowper's gland of the right side, with its duct. 12. The bulbous portion of the urethra. 13. The fossa navicularis. 14. The corpus cavernosum. 15. The right crus penis. 16. Near the upper part of the corpus cavernosum, the section has fallen a little to the left of the middle line; a portion of the septum pectiniforme is consequently seen. 17. The glans penis. 18. The lower segment of the glans. 19. The meatus urinarius. 20. The corpus spongiosum. 21. The bulb of the corpus spongiosum.

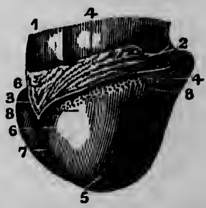
The Spongy Portion is about seven inches in length, Fig. 181. It presents two enlargements: the *bulbous*, and the *fossa navicularis*. The former, Fig. 181 (12), is situated in the lower part and near its commencement, and the latter, Fig. 181 (13), which is a lateral dilatation, near the meatus. Just in front of the bulbous portion are seen, on the lower surface, the *orifices* of the ducts of *Cowper's glands*, Fig. 181 (11). *Crypts*, or *lacunæ*, are found distributed over the whole surface. Some of these are the external orifices of canals which run backwards from half an inch to an inch beneath the mucous membrane. A very large one is sometimes met with on the upper surface, and about three-

quarters of an inch from the meatus; it is named the *lacuna magna*. A small, pointed catheter, or bougie, may enter one of these lacunæ, especially if it should happen to be unusually large. The *meatus urinarius*, Fig. 181 (19), is the external orifice of the urethra. It is a vertical slit in the lower and anterior part of the *glans*. The spongy portion of the urethra is surrounded by the corpus spongiosum, and the upper part of it also by the acceleratores muscles.

The CORPUS SPONGIOSUM, Fig. 181 (20), consists of a delicate erectile tissue, which surrounds the spongy portion of the urethra. It is expanded posteriorly to form the bulb, and anteriorly, to form the glans penis. It is thicker below, and on the sides of the urethra, than above it. It is covered by a thin fibrous lamina, from the inner surface of which numerous processes or trabeculæ project into its substance, and form there a fine network. The *bulb* is quite prominent, and projects backwards to the extent of three or four lines beneath the membranous part of the urethra. It is covered by a fibrous lamina reflected from the triangular ligament or deep perineal fascia.

The GLANS PENIS, Fig. 182, forms the head of that organ. It is of a somewhat conical shape. Its structure is the same as that of the corpus spongiosum. Its base is oblique from above downwards and forwards, and is excavated behind for the reception of the anterior extremities of the corpora cavernosa, over which the margin of its base projects and forms the *corona glandis*. It is much longer above than below, where there is a slight groove for the attachment of the *frænum præputii*.

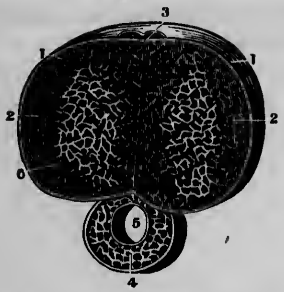
Fig. 182.



A VIEW OF THE GLANS PENIS INJECTED. — 1. Portions of the corpora cavernosa. 2. The prepuce turned back. 3. Its frænum. 4, 4. Glandulæ odoriferæ Tysoni. 5. Point of the glans penis. 6. Prominences of the glans on each side of the frænum. 7. The furrow which separates the sides of the glans. 8. Corona glandis.

The CORPORA CAVERNOSA, Fig. 181 (14), form the body of the penis. They consist of a spongy erectile tissue, inclosed in a dense white fibrous membrane. They are firmly attached, posteriorly, to the rami of the ischia, and the descending rami of the pubes. From these points of attachment they are directed upwards and forwards, increasing in size, to a point opposite the symphysis pubis, where they are joined to each other;

Fig. 183.



A Section of the Corpora Cavernosa Penis 1, 1, and Corpus Spongiosum Urethræ 4.—2, 2. Erectile tissue of the corpora cavernosa. 3. Septum pectiniforme. 5. Canal of the urethra. 6. Internal filaments of the corpora cavernosa which pass from the median septum to the external fibrous membrane.

these portions of them are named the *crura*, Fig. 181 (15). They terminate anteriorly in a rounded extremity, without any line of separation between them. They present a groove on the under surface in the median line for the lodgment of the urethra, and one above, which is occupied by the *dorsal vessels* and *nerves* of the penis. Internally they are separated by the *septum pectiniforme*, Fig. 183 (3). This is a perfect septum posteriorly, but consists, anteriorly, of fasciculi, which are connected above and below to the parietes common to the two bodies, resembling, as the name implies, the teeth of a comb. These fasciculi are loosely connected together anteriorly by areolar tissue. From the incompleteness of this septum, and the intimate connection existing between the two bodies, they might be regarded as constituting but one. From the inner surface of the walls of the corpora cavernosa processes are sent internally, which intersect and unite with each other so as to form a complete network, Fig. 183 (6). The trabecular arrangement is much coarser in these bodies than it is in the corpus spongiosum. The *trabeculæ* contain more or less of yellow fibrous tissue. There is very little if any vascular connection between the corpora cavernosa and the glans penis.

The Glands of Cowper, Fig. 181 (11), are two small bodies located just behind the bulb of the urethra. These ducts open into the urethra anterior to the sinus of the bulb; they are about an inch in length.

The Skin which covers the penis is very thin, extensible, and free from hair bulbs. It is connected to the parts beneath it by loose areolar tissue, which allows it to move on the parts which it covers with great facility. This areolar tissue contains no fat, but is very liable to be distended by serous effusions. It contains, on the dorsum, posteriorly, the

fibres which descend from the linea alba to form the *superficial suspensory ligament* of the penis. Some yellow elastic fibres are usually found in this ligament.

The PREPUCE, Fig. 182 (2), is formed by a duplicature of the skin, which projects over and sometimes beyond the glans penis. The reflected portion of it assumes the character of a mucous membrane, and is continued from the cervix over the glans to the orifice of the urethra, where it becomes continuous with the lining membrane of that canal. When the prepuce covers the glans so as to confine it, it forms what is called *phymosis*. When it becomes constricted behind the corona, it forms *paraphymosis*.

In the cervix, or depression behind the corona, there are some sebaceous glands, named the *glandulæ odoriferæ Tysoni*, Fig. 182 (4, 4).

The *frænum præputii*, Fig. 182 (3), consists of a triangular fold of the mucous membrane, which is attached to the groove in the glans just below and behind the meatus urinarius.

The *arteries* of the penis are derived principally from the internal pudic. The corpus spongiosum is supplied by the *bulbous* branches, which penetrate the bulb. The branches which are distributed to the corpora cavernosa enter the crura; they are called the *arteries of the corpora cavernosa*. The glans, the prepuce, and the skin, are supplied by the *dorsal* branches, which reach the dorsum of the penis by passing between the crura and perforating the suspensory ligament. The arteries which enter the spongy and cavernous bodies divide into a great number of branches; some of which are appropriated to the nourishment of the tissues, and others terminate by communicating freely with the *venous plexus* in the intertrabecular spaces.

The *veins* of the penis are large; they are divided into the *dorsal* or *superficial*, and the *veins of the corpora cavernosa*. The dorsal pass backwards beneath the symphysis pubis, and between the crura, to terminate in the prostatic and vesical plexuses, while those of the corpora cavernosa end in the internal pudic veins. The veins which proceed from the spongy structure commence by dilatations, which form plexuses in the intertrabecular spaces.

The *nerves* of the penis are derived mainly from the internal pudic.

Dissection of the Testicles.

The genital organs consist of the testicles, which secrete the semen, and the apparatus necessary for its transmission from the body; a part of their excretory apparatus, as the urethra, is common to both the genital and the urinary organs. The urethra, with the penis, has already been examined. Before examining the testicles, the coverings which they have independently of their proper tunics should be dissected. Being situated in the abdomen, in the early part of fœtal life, they obtain these investments in their descent into the scrotum. If the student has become familiar with the coverings of the bowel in oblique inguinal hernia, he will have little or no difficulty in understanding the different layers which cover the testicle. They are the following, proceeding from without inwards:—

The *integument* forms a pouch common to both testicles; it is named the *scrotum.* It is very thin, of a dark color, more or less wrinkled, and covered with hairs. A ridge is seen in the median line, called the *raphê;* this is continued backwards in the perineum, and forwards on the under surface of the penis.

The *dartos* is placed immediately beneath the skin, with which it is closely connected. It is continuous with the superficial fascia of the groin and the perineum. It forms two pouches, one for each testicle; the septum is attached above to the under surface of the penis. The dartos is composed principally of areolar tissue and non-striated muscular fibres. It supports the testicles, and when it contracts, necessarily corrugates the skin which is adherent to it.

The *intercolumnar* or *spermatic fascia* is derived from the margins of the external abdominal ring. The upper part of this contains some fibres prolonged downwards from the intercolumnar fibres.

The *cremaster muscle* consists in the scrotum of loops of scattered fasciculi connected together by condensed areolar tissue. The term *cremasteric fascia* has been applied to these fasciculi and the connecting areolar tissue.

The *fascia transversalis* is prolonged around the spermatic cord into the scrotum, and forms one of the coverings to the testicle.

The TUNICA VAGINALIS, Fig. 184 (1), was, before the descent of the testicle, a portion of the peritoneum. The testicle, while in the abdomen, is covered by the peritoneum in the same manner as the spleen or the liver, and when it descends into the scrotum carries along with it, not only the portion which adheres to its proper tunic, the *tunica albuginea*, but also a portion of the peritoneum which is attached to the walls of the abdomen. Hence the tunica vaginalis presents two portions, one of which is still adherent to the tunica albuginea, while the other is reflected over the inner surface of the pouch formed by the prolongation of the fascia transversalis. The latter is denominated the *tunica vaginalis reflexa*, and the former, the *tunica vaginalis testis*. They are analogous to the parietal and visceral portions of the pleura, or of the peritoneum, and, like these membranes, form a shut sac.

In studying the descent of the testicle, the student should bear in mind that it was just as much covered by the *peritoneum*, in the cavity of the abdomen, as it is by the *tunica vaginalis*, in the scrotum, and that the latter is to it in the scrotum, what the former was in the abdomen. The tunica vaginalis should be studied with reference to the occurrence of *hydrocele*, &c.

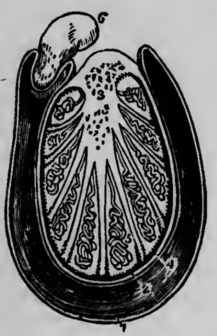
The TESTICLE is brought into view when the tunica vaginalis is laid open. It is of an oval form, flattened somewhat on the sides. It is about an inch and a half in length, and about three-fourths of an inch in thickness, and an inch in breadth. Its position in the scrotum is oblique, from above downwards, and from before backwards.

The EPIDIDYMIS is seen attached to its posterior border. This presents an upper large extremity, named the *globus major*, and a lower small one called the *globus minor;* the middle portion is named the *body*. The epididymis is partly covered by the tunica vaginalis. Having examined the exterior of the testicle, the tunica albuginea should be divided, and the glandular substance carefully removed, for the purpose of studying the structure of this tunic.

The TUNICA ALBUGINEA, Fig. 184 (2), is the proper capsule of the testicle. It is a thick, dense, white fibrous membrane. It preserves the form of this organ, and protects its delicate glandular structure. Behind, it forms a projection

internally, which is named the *corpus Highmorianum*, or *mediastinum testis*, Fig. 184 (3). From this fibrous bands pass off in different directions to be attached at various points to the inner surface of the tunic. These add very much to the strength of the fibrous structure of the testicle, and support the vessels as they penetrate the substance of the gland. The corpus Highmorianum is traversed by the bloodvessels and nerves which enter the interior of the testicle, and, also, by convoluted seminal tubes.

Fig. 184.



A TRANSVERSE SECTION OF THE TESTICLE.—1. The cavity of the tunica vaginalis. 2. The tunica albuginea. 3. Corpus Highmorianum or mediastinum testis. The cut ends of the vessels below the figure belong to the rete testis; those above, to the bloodvessels of the testicle. 4. Tunica vasculosa of the testis. 5. One of the lobules of the tubuli seminiferi terminating in a vas rectum. 6. A section of the epididymis.

It will be observed that from the dense and unyielding character of the tunica albuginea rapid effusion into the interior of the testicle would almost necessarily be attended with a great deal of pain.

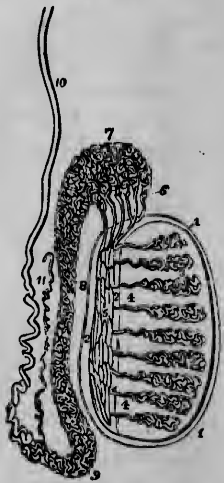
The TUNICA VASCULOSA, OR PIA MATER of the testicle, Fig. 184 (4), lines the internal surface of the tunica albuginea, and is reflected around the fibrous bands attached to its inner surface. It transmits the vessels to every part of the interior of the organ.

The GLANDULAR PORTION of the testicle consists of a great number of seminal tubes. These may be drawn out with the forceps to the extent of a foot or more; when this is done they appear at first like exceedingly fine, delicate threads, just unravelled from a network. They adhere very slightly to each other, and may be easily separated when allowed to float in water. They are arranged in *lobes* of a conical shape, and of different sizes; the bases of which look forwards, and the apices backwards. There are from three to four hundred of these lobes or bundles of convoluted tubes. Some of them commence by a blind extremity, and others are joined together so as to form loops.

The TUBULI SEMINIFERI, Fig. 185 (3, 3), unite to form about twenty tubes, which are nearly straight; these enter

the corpus Highmorianum. They are termed the *tubuli recti*, or *vasa recta*. These open into the *rete testis*, which consists of a network of tubes, in the anterior part of the corpus Highmorianum. From the rete testis from ten to twenty tubes pass through the tunica albuginea. They are called the *vasa efferentia*. These are at first straight, but become convoluted, and form masses of a conical shape, which are named the *coni vasculosi*. These cones form the globus major or head of the epididymis, and by uniting together form a single tube, called the *canal of the epididymis*. This tube, after forming the body and the globus minor or tail of the epididymis, terminates in the *vas deferens*.

Fig. 185.



A VIEW OF THE MINUTE STRUCTURE OF THE TESTIS.—1, 1. Tunica albuginea. 2, 2. Corpus Highmorianum. 3. 3. Tubuli seminiferi convoluted into lobes. 4, 4. Vasa recta. 5. Rete testis. 6. Vasa efferentia. 7. Coni vasculosi constituting the globus major of the epididymis. 8. Body of the epididymis. 9. Its globus minor. 10. Vas deferens. 11. Vas aberrans, or blind duct.

The VAS DEFERENS, Fig. 185 (10), and Fig. 186 (6, 6), commences at the lower end of the globus minor, and is directed upwards on the inner side of the epididymis. It enters the spermatic cord at the upper part of the testicle, and ascends in the posterior part of it to the internal abdominal ring, where it leaves the cord, and turning short round the epigastric artery, passes downwards and inwards over the external iliac vessels, and enters the pelvis. In the pelvis it crosses over the ureter, gets between the rectum and the bladder, and passes downwards and forwards, on the inner side of the vesicula seminalis, to the upper border of the prostate gland, where it unites with the *ductus vesiculæ seminalis*, to form the *ductus ejaculatorius communis*.

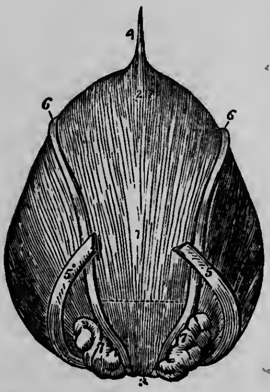
The vas deferens is composed of an inner mucous, and an outer fibrous layer. The latter is very thick and firm, so that the tube can be distinctly felt in the spermatic cord of the living subject. The vas deferens is about two feet in length. Its size does not vary much from its commencement

until it reaches the bladder, where it enlarges, and becomes sacculated.

The VAS ABERRANS, Fig. 185 (11), is a small tube which is sometimes found arising from the globus minor, or the commencement of the vas deferens, and extending a short distance upwards in the spermatic cord. It terminates in a blind extremity. Its use is not known.

The VESICULÆ SEMINALES, Fig. 186 (7, 7), are two sacculated bodies, situated on the base of the bladder, above the prostate gland, and in front of the rectum. They are each about two inches in length, and half an inch in breadth. They approach each other from above downwards, so as to leave a triangular space between them, in which the vasa deferentia are situated. When fully dissected out, each one is found to be from four to five inches in length. They are lined by mucous membrane, outside of which is a proper fibrous layer. They also receive a layer from the prostatic fascia, which attaches them to the bladder. Each one terminates in a short tube, the *ductus vesiculæ seminalis*.

Fig. 186.



THE POSTERIOR ASPECT OF THE MALE BLADDER; THE SEROUS COVERING IS REMOVED IN ORDER TO SHOW THE MUSCULAR COAT.—1. The body of the bladder. 2. Its fundus. 3. Its inferior fundus or base. 4. The urachus. 5, 5. The ureters. 6, 6. The vasa deferentia. 7, 7. The vesiculæ seminales.

The DUCTUS EJACULATORIUS COMMUNIS, Fig. 181 (8), is about an inch in length. It passes forwards, upwards, and somewhat inwards, between the middle and lateral lobes of the prostate gland to open on the caput gallinaginis, in the floor of the prostatic portion of the urethra. At first the two ejaculatory ducts are a little distance apart, but lie close to each other in the latter part of their course. Their walls in the prostate gland are very thin, and some care is requisite to dissect them out entire.

The SPERMATIC CORD is composed of the vas deferens and the spermatic vessels and nerves. It extends from the back

part of the testicle to the internal abdominal ring. The left cord is somewhat the longest. The *spermatic artery* is a branch from the aorta. It enters the testicle through the corpus Highmorianum, and divides into numerous small branches, which ramify in the substance of the gland. The *spermatic veins* commence in the testicle, and leave it in company with the artery. Just above the testicle they form a plexus named the *plexus pampiniformis*. They contain no valves. Those on the right side terminate by a single trunk in the ascending cava, and those on the left side in the renal vein. The *nerves* of the testicle are derived from the plexus which accompanies the spermatic artery.

Relations of the Pelvic Viscera in the Male.

The pelvic viscera of the male consist of the *rectum*, the *bladder*, the *vesiculæ seminales*, and the *prostate gland*. The rectum occupies the posterior part, and the other organs the anterior part.

In studying the relations of the RECTUM, it may be divided into two parts, the *upper* and *lower;* the first being in direct relation with the peritoneum, and the last having no serous covering.

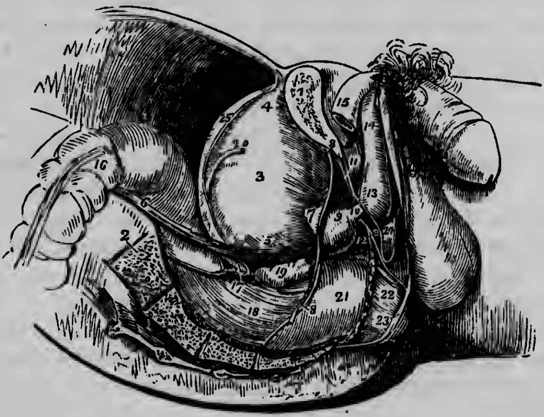
The *upper part*, Fig. 187 (16), extends downwards to the recto-vesical fascia, or to within about three-quarters of an inch of the prostate gland. The whole of this part is covered in front, and partly on the sides, by the peritoneum, and is in relation with the bladder, and usually with the small intestines; the superior portion is also covered behind by peritoneum, except a small space between the laminæ of the mesorectum. Below it is in apposition with the sacrum, the pyriform muscles, the branches of the internal iliac arteries, the sacral nerves, and the ureters, especially the one on the left side.

The *lower part*, Fig. 187 (18), is in relation behind and on the sides with the sacrum and coccyx, and the coccygeus and levatores ani muscles. It has in front of it, commencing above, first, the vesiculæ seminales and the triangular space between them on the base of the bladder; second, the prostate gland; third, the membranous portion of the urethra

and the bulb. Some portions of the rectum are separated from the surrounding parts by a considerable quantity of adipose and areolar tissue.

As the BLADDER, Fig. 187 (3, 4, 5), varies in size according as it is empty or distended, its relations to contiguous parts are necessarily modified. When empty, it is in relation *an-*

Fig. 187.



A SIDE VIEW OF THE VISCERA OF THE MALE PELVIS, IN SITU. THE RIGHT SIDE OF THE PELVIS HAS BEEN REMOVED BY A VERTICAL SECTION MADE THROUGH THE OS PUBIS NEAR THE SYMPHYSIS; AND ANOTHER THROUGH THE MIDDLE OF THE SACRUM.—1. The divided surface of the os pubis. 2. The divided surface of the sacrum. 3. The body of the bladder. 4. Its fundus; from the apex is seen passing upwards, the urachus. 5. The base of the bladder. 6. The ureter. 7. The neck of the bladder. 8, 8. The pelvic fascia; the fibres immediately above 7 are given off from the pelvic fascia, and represent the anterior ligaments of the bladder. 9. The prostate gland. 10. The membranous portion of the urethra, between the two layers of the deep perineal fascia. 11. The deep perineal fascia formed of two layers. 12. One of Cowper's glands between the two layers of deep perineal fascia, and beneath the membranous portion of the urethra. 13. The bulb of the corpus spongiosum. 14. The body of the corpus spongiosum. 15. The right crus penis. 16. The upper part of the rectum. 17. The recto-vesical fold of peritoneum. 18. The lower portion of the rectum. 19. The right vesicula seminalis. 20. The vas deferens. 21. The rectum covered by the descending layer of the pelvic fascia. 22. A part of the levator ani muscle investing the lower part of the rectum. 23. The external sphincter ani. 24. The interval between the deep and superficial perineal fascia; they are seen to be continuous beneath the number. 25. Peritoneum covering the upper and back part of the bladder.

teriorly with the symphysis pubis, the pubic bones, and obturator muscles; and when distended, with the anterior walls of the abdomen. In the latter case, the peritoneum is raised

up so as to leave a non-peritoneal surface above the symphysis, when the bladder can be cut into for the purpose of removing calculi or evacuating its contents without injuring the peritoneum. It can also be perforated through the symphysis. *Posteriorly*, it is in contact, above, with the rectum and with the small intestines, and, when filled, with the sigmoid flexure of the colon; below, with the vesiculæ seminales, the vasa deferentia, and the rectum. Sometimes, and especially when empty, the recto-vesical *cul-de-sac* extends down to the prostate gland and interposes between the vesical triangle and the rectum. It is through this triangular space that the bladder is sometimes perforated from the rectum. When this operation is performed it should be done close to the prostate gland to avoid the peritoneum, and in the median line, so as not to injure the vesiculæ seminales and the vasa deferentia. *Laterally*, the bladder is in relation on each side above, with the remains of the hypogastric artery and the vas deferens; and below, with the levator ani muscle and the pelvic fascia. Its *neck*, Fig. 187 (7), is in apposition with the prostate gland.

The bladder is retained *in sitû* by ligaments, by fasciæ, and by the peritoneum. The ligaments of the bladder are designated the true and the false. The *false* consists simply of two folds of peritoneum, one on each side of the *cul-de-sac* between the bladder and the rectum; they are sometimes called the *posterior ligaments* of the bladder. The *anterior true ligaments* arise from the lower part of the pubic bones, and are inserted into the neck of the bladder. The *lateral true ligaments* are derived from the pelvic fascia, and will be described in connection with it.

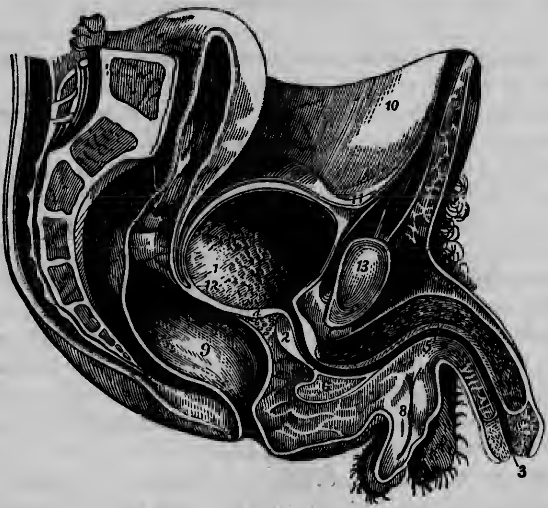
The PROSTATE GLAND, Fig. 188 (2), is in relation, *above*, with the anterior ligaments of the bladder; on the *sides* with the levatores ani, and *below*, with the rectum. It is from two to two and a half inches above the anus. Its base corresponds to the neck of the bladder and its apex to the membranous portion of the urethra.

The relations of the membranous portion of the urethra and the bulb will be described in this place preparatory to the examination of the perineal fasciæ.

The MEMBRANOUS PORTION of the urethra, Fig. 187 (10), is situated below the arch of the pubes and extends from the

prostate gland to the bulb. It is in front of the rectum, from which it is separated by a triangular space, the base of which looks downwards and forwards towards the bulb and the pe-

Fig. 188.



ANTERO-POSTERIOR SECTION OF THE PELVIS OF A MALE, EXHIBITING THE VISCERA IN THEIR NATURAL SITUATION, AND THE CURVATURES OF THE URETHRA.—1. The bladder. 2. The prostate. 3, 3. The urethra, laid open through its whole extent. 4. The seminal vesicle, laid open. 5. The spongy body, seen both above and below the urethra. 6. The bulb of the spongy body. 7. The cavernous body of the penis. 8. The right side of the scrotum. 9. The rectum. 10. The peritoneal lining of the abdominal muscles. 11. The peritoneal investment of the bladder. 12. The point where the peritoneum is reflected from the bladder upon the rectum. 13. The section of the pubic symphysis. 14. A line marking the situation of the triangular ligament.

rineal centre; the apex is directed upwards and backwards to the point where the prostate gland rests against the rectum. It is about an inch below the symphysis, from which it is separated by an elastic and spongy structure, the muscles of Guthrie and Wilson, and the deep perineal fascia.

The BULB of the corpus spongiosum, Fig. 187 (13), corresponds to the upper part of the pubic arch, and is anterior to the triangular ligament. It is about three-fourths of an inch in front of the rectum. It is covered below by the in-

tegument, the common superficial fascia, the superficial perineal fascia, and the ejaculatores urinæ muscles.

Dissection of the Vessels and Nerves in the Pelvic Cavity.

The principal vessels and nerves in the pelvic cavity can be examined without removing any portion of the bones that form its parietes; to make a thorough dissection of them, however, the os innominatum on one side should be disarticulated and removed; or any portion of it may be cut away, including any part of the sacrum that may be found necessary in the progress of the dissection. The saw, or a mallet and chisel may be used for this purpose. To trace the vessels which supply the bladder and rectum, these organs should be moderately distended, the former with air, and the latter with cotton or tow. If the arteries be well injected but little difficulty will be encountered after the peritoneum has been removed, in exposing all the principal branches, as far as the organs which they supply or the openings through which they leave the pelvic cavity.

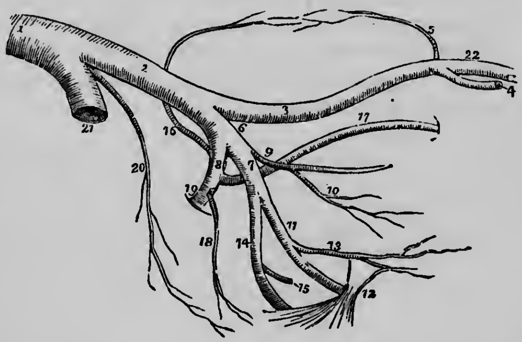
The *Middle Sacral Artery* seems to be a continuation of the aorta greatly diminished in size. It extends in the median line from the bifurcation of the aorta to the coccyx, passing over the body of the last lumbar vertebra and the sacrum. In its course it gives off small branches, some of which anastomose with the lateral sacral arteries, and others enter the meso-rectum.

The Internal Iliac or Hypogastric Artery, Fig. 189 (6), Fig. 190 (6), furnishes most of the branches found in the pelvis. It arises from the bifurcation of the common iliac artery opposite the sacro-iliac symphysis, and descending into the pelvis terminates near the upper border of the great sacro-sciatic foramen. It varies in length from an inch to an inch and a half. Near its origin it is separated from the peritoneum by the ureter. The lumbo-sacral nerve lies behind it; the internal iliac vein is situated behind and a little to the outer side of it. In the fœtus the internal iliac is continued to the umbilicus, where it becomes the umbilical artery. Commencing at the origin of the vesical artery a

ligamentous cord will be observed extending on the side of the bladder to the anterior parietes of the abdomen, and thence to the umbilicus; this is the remains of the hypogastric artery of the fœtus. The folds of peritoneum formed by these fibrous cords, there being one on each side, were noticed in the examination of that membrane. The vasa deferentia pass over these cords.

The branches of the internal iliac artery vary so much in their origin that no fixed rule, perhaps, need be observed in describing them. They will be noticed in the order in which it will be found most convenient to examine them in the dissection. The internal iliac very frequently divides into two principal trunks, from which the branches proceed. They are designated the *anterior* and *posterior* divisions, Fig. 189 (7, 8). When this division exists, the latter usually gives off

Fig. 189.



A DIAGRAM OF THE ILIAC ARTERIES AND THEIR BRANCHES.—1. The aorta. 2. The left common iliac artery. 3. The external iliac. 4. The epigastric artery. 5. The internal circumflex ilii. 6. The internal iliac artery. 7. Its anterior division. 8. Its posterior division. 9. The umbilical artery giving off (10) the superior vesical artery. After the origin of this branch the umbilical artery becomes converted into a fibrous cord—the umbilical ligament. 11. The internal pudic artery passing behind the spine of the ischium (12) and small sacro-sciatic ligament. 13. The middle hemorrhoidal artery. 14. The sciatic artery, also passing behind the small sacro-sciatic ligament to escape from the pelvis. 15. Its inferior vesical branch. 16. The ilio-lumbar, the first branch of the posterior division (8) ascending to anastomose with the internal circumflex ilii artery (5), and form an arch along the crest of the ilium. 17. The obturator artery. 18. The lateral sacral. 19. The gluteal artery escaping from the pelvis through the upper part of the great sacro-sciatic foramen. 20. The sacra media. 21. The right common iliac artery cut short. 22. The femoral artery.

the gluteal, the ilio-lumbar, and the lateral sacral, while the former supplies the remaining branches or arteries.

The *ilio-lumbar artery*, Fig. 189 (16), arises from the back part of the internal iliac, near its origin, passes outwards behind the external iliac artery and vein and the psoas magnus, to divide into a *lumbar* and an *iliac* branch. The former passes upwards, and sends off branches to the psoas and quadratus lumborum muscles, to the spinal canal, and to anastomose with the last lumbar artery. The latter passes downwards and outwards as far as the crest of the ilium, where it anastomoses with the internal circumflex ilii; sometimes it is found ramifying in the iliacus internus muscle, or beneath it on the surface of the bone. By means of this artery an anastomotic connection is established between the internal and external iliac arteries.

The *obturator artery*, Fig. 189 (17), not unfrequently has its origin from some other than the internal iliac artery, as the external iliac, the epigastric, or the femoral. The course it takes to reach the inner part of the thigh will vary with its origin. When it arises from the internal iliac it passes horizontally forwards just below and on the inner side of the brim of the pelvis to the sub-pubic groove in the upper border of the obturator foramen. The obturator nerve lies above it, but follows the same course. When it arises from either of the other arteries mentioned above, it passes inwards over the brim of the pelvis, to enter the sub-pubic groove. When it has its origin from the femoral artery, however, it first passes upwards through the femoral ring, and then inwards. Its relations to the femoral ring are noticed in connection with the anatomy of femoral hernia. It usually gives off several small branches in the pelvis, in its course to the thigh; the most important of which is a branch that anastomoses with the epigastric; sometimes this is quite large, and deserves special notice from its relation to femoral hernia. Having passed through the obturator foramen, the obturator artery divides into two principal branches, an *internal* and *external*. These are distributed to the muscles on the inner and back part of the thigh. The external division sends a small branch through the notch at the lower part of the acetabulum to supply the hip-joint; by means of the ligamentum teres the head of the femur is partly supplied from this branch.

Fig. 190.

The *vesical arteries*, Fig. 190 (11), consist of two principal branches, a *superior* and an *inferior*. The *former* is usually a continuation of that part of the hypogastric artery in the fœtus, which, instead of being converted into a ligamentous cord, remains pervious after birth. It ramifies on the back, sides, and fundus of the bladder; sometimes a branch extends upwards from the summit towards the umbilicus. The *latter*, or *vesico-prostatic*, commonly arises directly from the internal iliac, and is distributed to the neck and lower part of the bladder, to the prostate gland, to the corresponding seminal vesicle, and the upper part of the urethra. A small branch is sent to the vas deferens, named the *deferential artery;* also another one to the ureter. The inferior artery of the bladder varies very much in its origin. Besides these branches the bladder is generally supplied with several small branches derived from other sources.

The Arteries of the Pelvis and Thigh, as seen from the Inner Side, by a Vertical Section.—1. Inferior extremity of the abdominal aorta, just where it divides into the iliac arteries. 2. Right primitive iliac. 3. Right external iliac. 4. Origin of epigastric artery. 5. Internal circumflex ilii. 6. Hypogastric or internal iliac artery. 7. Ilio-lumbar. 8. Gluteal. 9. Obturator. 10. Lateral sacral. 11. Vesical arteries cut off. 12. Middle hemorrhoidal. 13. Internal pudic. 14. Ischiatic. 15. Commencement of the femoral artery at the crural arch. 16. Point where it passes through the adductor magnus. 17, 20, 21. Arteria profunda. 18. Internal circumflex. 19, 19, 19. First, second, and third perforating arteries. 22. A branch to the vastus internus. 23. Femoral artery passing through the canal formed by the tendon of the adductor magnus. 24. The anastomotica. 25. A branch to the sartorius muscle. 26. Popliteal artery. 27. The same artery behind the knee-joint under the soleus muscle. 28. A supernumerary articular artery. 29. Superior internal articular artery. 30. Inferior internal articular artery. 31. Anastomosis of the three last with anastomotica.

The *middle hemorrhoidal* artery, Fig. 190 (12), arises from the internal iliac, sometimes from the inferior vesical or the internal pudic, passes to the side of the rectum, where it anastomoses with the superior and inferior hemorrhoidal arteries. It is very irregular in its origin, and sometimes is absent.

The *uterine artery* arises from the internal iliac, and, passing between the layers of the broad ligament, reaches the uterus just above the os tincæ. It then ascends on the border to the fundus, giving off branches in its course, which ramify on the anterior and posterior surfaces of the uterus; some of these penetrate its substance, others anastomose in the median line with the corresponding branches on the opposite side. It sends small branches to the bladder and ureters. During the period of pregnancy, the uterine arteries attain to a great size, and become exceedingly tortuous.

The *ovarian arteries* anastomose freely with the uterine. They arise from the aorta, and pursue a course downwards similar to that of the spermatic arteries in the male until they reach the brim of the pelvis, when they are directed inwards to get between the layers of the broad ligaments. Each one penetrates the ovary at its attached border. In their course to the ovaries they are very much convoluted. They send branches to the Fallopian tubes and to the round ligaments; the latter branches accompany the Fallopian tubes to their destination.

The *vaginal artery* arises in common with the inferior vesical, or from the hypogastric, just before or after that artery. It passes downwards on the side of the vagina to near its external orifice, when it gets behind it, between the vagina and rectum, to anastomose with branches from the opposite side. It sends branches in its course to the bladder and the urethra, also to the rectum.

The *lateral sacral arteries*, Fig. 190 (10), usually consist of two, a superior and inferior, on each side. They arise close to each other just above the gluteal. The *superior* passes downwards and inwards to the first sacral foramen, which it enters to reach the sacral canal, where it divides into two branches; one of these escapes from the canal through the corresponding posterior sacral foramen, and is distributed to the muscles and integument of the back, while the other ramifies in the canal. The *inferior* descends in front of the

pyriformis muscle and sacral nerves and on the inner side of the anterior sacral foramina to the side of the coccyx. It gives off small branches which enter the sacral foramina, and have each one of them the same distribution as the superior lateral sacral artery. Besides the branches which enter the sacral canal, these arteries give off branches that anastomose with the middle sacral artery and ramify on the anterior surface of the sacrum; and also others which go to the pyriformis muscle and the sacral nerves.

The *gluteal artery*, Fig. 190 (8), from its size, might be regarded as a continuation of the internal iliac. It escapes from the pelvis at the upper part of the great sacro-sciatic foramen between the gluteus medius and pyriformis muscles. In its course downwards and backwards it passes between the lumbo-sacral and the first sacral nerve. In the pelvis it gives off a nutritious branch to the ilium and one or more muscular branches. Having escaped from the pelvis it divides into a *superficial* and a *deep branch*, which will be noticed in the dissection of the gluteal region.

The *sciatic* or *ischiatic artery*, Fig. 190 (14), varies in its origin. Not unfrequently it arises in common with the internal pudic, from which it does not separate until just before it leaves the pelvis. It passes downwards in front of the pyriformis muscle and sacral plexus of nerves to the lower part of the great sacro-sciatic foramen, where it is placed between the pyriformis and superior gemellus muscles, having the great sciatic nerve on the inner side of it and the internal pudic artery behind it. It gives off in its course in the pelvis the *coccygeal* branch, which perforates the great sacro-sciatic ligament and ramifies on the dorsum of the coccyx. As it leaves the pelvis, it sends off a branch named the *comes nervi ischiadici* to accompany the great sciatic nerve. Its course and distribution outside the pelvis will be examined in the dissection of the gluteal region and upper and back part of the thigh.

The *internal pudic artery*, Fig. 190 (13), has the same direction and relations in the pelvis as the sciatic artery, which it accompanies to the spine of the ischium, around which it winds to enter the perineum. Its course and branches in the perineum will be observed in the dissection of that region. It is in some respects the most important branch given off from the internal iliac, to be studied. This is

owing to its liability to injury in cutting for stone and in other operations in the perineum. Before it leaves the pelvis it supplies branches to the levator ani muscle, the rectum, the bladder, the vesiculæ seminales, and to the prostate gland. Its distribution in the female differs from that in the male. While within the pelvis in the female, besides sending branches to the bladder and rectum, it sends branches to the vagina; in the perineum the branches that correspond to those which go to the penis in the male are distributed to the clitoris.

The INTERNAL ILIAC VEIN is placed on the inner side of the internal iliac artery with which it corresponds. It receives the blood from the veins that accompany the branches of the internal iliac artery, and also from the vesico-prostatic plexus, including that portion of the blood contained in the hemorrhoidal plexus which does not find its way to the inferior mesenteric vein and thence to the portal vein. It has no valves. It is exceedingly important that every student should thoroughly understand the plexuses of veins connected with the rectum and genito-urinary apparatus. It will be seen that a part of the blood from these plexuses reaches the heart through the internal and common iliac veins and the vena cava, while another portion passes through the mesenteric and portal veins to the liver, and thence through the hepatic veins and vena cava to the heart. Each artery has its venæ comites, which unite to open into their main trunk by a common orifice.

The *ilio-lumbar vein* opens into the common iliac. It is united to the veins which escape from the spinal canal through the lower lumbar intervertebral foramina; also to a vein which lies in front of the last lumbar vertebra, and to the lateral sacral veins by an anastomosing branch.

The *middle sacral* and the *lateral sacral veins* correspond to the arteries of the same names. The former arises in front of the coccyx, and passes upwards to terminate in the left common iliac vein. Not unfrequently a communicating branch is found connecting this vein with the hemorrhoidal plexus, and also with the vesical plexus. The latter consist of two or more veins, which open into the common iliac vein.

The veins which accompany the gluteal, the sciatic, the

obturator, and the internal pudic artery, require no particular description.

The *hemorrhoidal veins* and *plexus* are situated in the parietes of the lower part of the rectum. They consist of the superior, middle, and inferior hemorrhoidal veins, which empty, the superior into the inferior mesenteric, and the middle and inferior into the internal iliac vein, or a branch of it. A venous network is found just beneath the mucous membrane, and close to the anus. Hemorrhoids are very frequently caused by the dilatation of the veins that form this network or plexus, as was noticed in the dissection of the rectum.

The *vesico-prostatic plexus*, Fig. 199 (9), is situated in the upper pouch or pocket formed by the deep perineal and pelvic fasciæ, by which the veins that form a portion of the plexus are prevented from becoming very much distended. It covers the prostate gland and the neck of the bladder. In cutting for stone, this plexus is necessarily more or less wounded, which may give rise to a good deal of hemorrhage, the amount depending on the condition of the veins at the time of the operation. Behind, it communicates with the hemorrhoidal plexus; in front and below with the veins which surround the membranous portion of the urethra; it also receives the contents of the dorsal veins of the penis. These veins, after passing through the sub-pubic ligament and deep perineal fascia, unite to form a single trunk, which divides these into a right and left vein, in order to join the prostatic plexus on both sides of the prostate gland. The veins from the dorsum of the penis are kept constantly open where they perforate the dense fibrous structure of which the sub-pubic ligament and deep perineal fascia are composed. They also communicate freely with the deep veins, or those which accompany the branches of the internal pudic artery.

The *spermatic veins* were noticed in the dissection of the testicle. They communicate with the dorsal veins of the penis, and with the pudic veins. There is occasionally a communication existing between the spermatic vein and the portal system.

The *ovarian veins* are formed by branches derived from the uterus, the ovaries, and the Fallopian tubes. They accompany the ovarian arteries, and have the same termination as the spermatic veins.

The *vaginal plexus* of veins surrounds the vagina. Near the vulva the plexus is composed of a great number of veins, many of which have their origin in the erectile tissue that is found around the external orifice of the vagina. The veins of the vaginal plexus communicate behind, with the hemorrhoidal plexus, and before, with the vesical plexus.

The *uterine veins* correspond on the exterior surface of the uterus to the uterine arteries. They arise from *venous canals*, or *sinuses*, which traverse the substance of the uterus, without, however, being tortuous like the arteries. The veins, as well as the arteries of this organ, increase greatly in size during the period of pregnancy.

The *nerves* which supply the pelvic viscera are derived from the lumbo-sacral, the anterior sacral, and the sympathetic system.

Besides the visceral nerves, there are several small branches derived from the sacral nerves or plexus, and appropriated to the muscles within the pelvis and perineum. There is also found in the pelvis a branch from the lumbar plexus called the *obturator nerve*, which from its position should be examined first.

The *obturator nerve*, Fig. 191 (6), arises from that portion of the lumbar plexus which is formed by the third and fourth lumbar nerves. To reach the pelvis, it first passes through the psoas magnus muscle, and then runs for some distance on its inner side; it then crosses over the brim of the pelvis, and gets below the external iliac vein and above the obturator artery, which it accompanies to the sub-pubic groove, when it enters the upper and inner part of the thigh. After perforating the psoas muscle, it passes beneath the bifurcation of the common iliac vessels. In the pelvis, near the obturator foramen, it usually gives off one or two *articular branches* to the hip-joint. As it enters the thigh it divides into the *superficial* or *anterior division*, and the *deep* or *posterior division*. These are distributed principally to the muscles on the inner part of the thigh, and will be noticed in the dissection of that region.

When the *obturator accessory nerve*, Fig. 191 (5), is present, and of its usual size, it supplies the hip-joint with *articular* filaments instead of the obturator nerve itself. The accessory nerve has the same origin as the obturator nerve; of which it is sometimes a part for a short distance, when it becomes a

separate nerve. It perforates the psoas muscle, and descends on its inner side to the pubes, which it passes over on the inner side of the ilio-pectineal eminence to get beneath the pectineus muscle, where it gives off its articular filaments to the hip-joint and divides into several other branches; one of which descends as low as the upper and back part of the leg, sending in its course a filament to the knee-joint.

The *superior gluteal nerve*, Fig. 192 (2), may be examined next. It arises from the lumbo-sacral before it joins the first sacral nerve to become a part of the sacral plexus. It escapes from the pelvis in company with the gluteal artery through the upper part of the great sacro-sciatic foramen, above and in front of the pyriformis muscle, and divides into two branches which correspond in their distribution with the gluteal artery. It supplies the gluteus medius, minimus, and tensor vaginæ femoris muscles.

The *lumbo-sacral nerve*, Fig. 192 (1), is formed by the union of the descending portion of the fourth lumbar, and the fifth lumbar. It enters the pelvis, and assists in forming the sacral plexus.

There are six anterior sacral nerves, including what is sometimes called

Fig. 191.

The Lumbar Plexus and its Branches (slightly altered from Schmidt).—*a*. Last rib. *b*. Quadratus lumborum muscle. *c*. Oblique and transverse muscles, cut near the crest of the ilium. *d*. Os pubis. *e*. Adductor brevis muscle. *f*. Pectineus. *g*. Adductor longus. 1. Superior musculo-cutaneous branch. 2. Middle musculo-cutaneous branch. 3. Inferior musculo-cutaneous branch. 4. Anterior crural nerve. 5. Accessory obturator. 6. Obturator nerve. 7. Genito-crural nerve dividing into two at its origin from the plexus. 8, 8. Gangliated cord of the sympathetic nerve.

the *coccygeal nerve.* They escape from the sacral or lower part of the spinal canal, through the anterior sacral foramina.

The *first* and *second nerves* are quite large, and of nearly the same size. The *first* being joined by the lumbo-sacral, passes obliquely downwards over the pyriformis muscle to the sacral plexus. The *second* nerve proceeds more obliquely outwards than the first to join the plexus.

The *third nerve*, as it goes to join the sacral plexus, has a still more oblique direction, being nearly horizontal. It is only about one-fourth the size of the first and second nerves. To the latter nerve it is connected by a filament, which will be seen passing over the pyriformis muscle.

The *fourth nerve* is very much smaller than the third. A part of it only goes to join the sacral plexus. The rest of it sends branches to join the hypogastric plexus of the sympathetic nerve, one to join the fifth nerve, and others to supply the levator ani, the coccygeus and sphincter ani muscles.

The *fifth nerve* usually passes through the foramen formed by the sacrum and coccyx. It is much smaller than the fourth, to which it is joined by a communicating branch; it sends a branch to the sixth nerve.

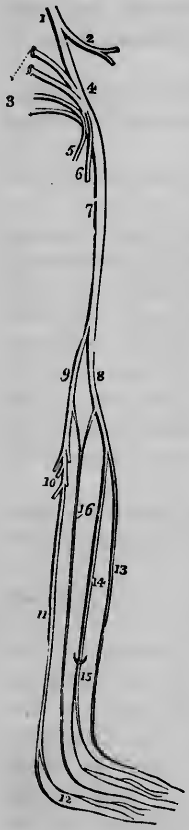
The *sixth sacral* or the *coccygeal nerve* is generally very small; it emerges at the lower end of the spinal canal; from which point it should be traced.

It will be observed that of the sacral nerves only the first three, and a part of the fourth, contribute to form the sacral plexus. Each one of them is joined to a ganglion of the sympathetic nerve by a communicating branch; they are also connected to each other by a similar branch.

The SACRAL PLEXUS, Fig. 192 (4), is formed, as has been seen, by the union of four whole nerves and portions of two others. The whole nerves are the last lumbar and the first three sacral; the parts are derived from the fourth lumbar and the fourth sacral nerve. The shape of the plexus is triangular; its base looks towards the foramina through which the nerves that form it escape from the spinal canal, while its apex corresponds to the beginning of the great sciatic nerve, which is close to the lower part of the great sciatic foramen through which this nerve makes its exit from the pelvis.

The sacral plexus is more simple in its structure than any other belonging to the spinal system of nerves.

Fig. 192.



The plexus lies on the anterior surface of the pyriformis muscle; in front, it corresponds to the lower part of the rectum, from which it is separated by a fascia and branches of the internal iliac vessels. In exposing the sacral nerves and plexus, much care is requisite to preserve the nerves which arise from them, and which should now be traced to their destination if they end in the pelvis, and to their exit from the pelvis if they go to supply parts outside of it.

To do this no specific directions can be given, as they vary so frequently in their origin and general arrangement; this is more particularly the case with the nerves which supply the viscera. These may arise partly from the second and third nerves, or partly from the plexus, or almost wholly from the fourth and fifth nerves. They may go in part directly to the viscera which they supply, as the rectum, the bladder, and the prostate gland, in the male; and, in the female, to the bladder, the uterus, the vagina, and the rectum; or they may, some of them at least, join filaments of the sympathetic nerve, as the hypogastric plexus, and, in company with them, reach the same organs. As they are so intimately connected with the hypogastric plexus and the filaments derived from it, the two sets of nerves should be examined

A Diagram showing the Formation and Branches of the Sacral Plexus.—1. The lumbo-sacral nerve, descending to join the sacral plexus, and giving off a large branch. 2. The superior gluteal nerve. 3. The anterior branches of the four upper sacral nerves. 4. The sacral plexus. 5. The internal pudic nerve. 6. The lesser sciatic nerve. 7. The great sciatic nerve. 8. The peroneal nerve. 9. The popliteal nerve. 10. Its sural branches. 11. The posterior tibial nerve dividing inferiorly into the two plantar nerves, 12. 13. The anterior tibial nerve. 14. The musculo-cutaneous nerve, its muscular portion. 15. Its cutaneous portion. 16. The external saphenous nerve, formed by the union of the communicans poplitei, and communicans peronei.

together; they will be referred to again in the dissection of the sympathetic nerve in the pelvis.

Although a knowledge of these nerves possesses but little value as applied to surgical operations, its value cannot be estimated when viewed in connection with injuries and diseases in which the pelvic organs, either in the male or female, are directly or indirectly involved.

The following are the muscular nerves derived from the sacral plexus or nerves and distributed principally to the muscles in the pelvis and perineum.

The *nerve to the pyriformis*, generally, comes from the posterior aspect of the plexus, but sometimes it proceeds from one of the sacral nerves before it enters the plexus; sometimes there are two of these small nerves, or one which divides it into two branches before penetrating the muscle.

The *nerves to the levator ani* are usually two branches of the fourth sacral nerve. Besides these, this muscle commonly receives *two* or *three filaments* from the vesical and hemorrhoidal nerves. The first of these nerves, or those from the fourth sacral nerve, penetrate the pelvic surface of the muscle, the largest one near its centre and the other near its anterior border.

The *nerve to the obturator internus* proceeds from the upper and anterior portion of the sacral plexus, passes around the spine of the ischium and through the small sacro-sciatic foramen, when it divides into two or three branches which spread out and penetrate the inner surface of the muscle.

The *inferior hemorrhoidal nerve* arises from the posterior part of the sacral plexus near the internal pudic, or from the internal pudic itself, which it accompanies through the small sacro-sciatic foramen to near the upper border of the sphincter ani muscle, where it divides into several small branches. Some of these penetrate the muscle at different points, while others proceed to the integument around the anus; others still pass forwards and anastomose with the superficial perineal nerve and the perineal branch of the lesser sciatic nerve. The inferior hemorrhoidal nerve corresponds in its distribution with the artery of the same name. The sphincter ani is also supplied in part by filaments which proceed to it directly from the fourth and fifth sacral nerves; and also from the internal pudic. And again, the inferior

hemorrhoidal nerve is occasionally wholly cutaneous, sending no filaments to the sphincter muscle.

The *coccygeus muscle* is supplied with filaments derived from the fourth and fifth sacral nerves, and the coccygeal nerve. One or two of these nerves, after perforating the coccygeus muscle, become cutaneous, and supply the integument behind the anus and on the back of the coccyx.

Two small nerves usually arise from the sacral plexus which are distributed to the *gemelli* and *quadratus femoris muscles*, and also to the *hip-joint*. The one that supplies the superior gemellus arises from the plexus near the origin of the internal pudic. The one that goes to the inferior gemellus and quadratus femoris arises from the plexus at or near the commencement of the great sciatic nerve, passes downwards behind the superior gemellus and obturator internus muscles, between them and the capsule of the hip-joint, to reach the deep surface of the muscles to which it is distributed. Besides supplying these muscles, this nerve sends filaments to the hip-joint.

The *internal pudic* or *superior long pudendal nerve* arises from the lower part of the sacral plexus, and soon joins the internal pudic artery which it accompanies through the small sacro-sciatic foramen to the perineum, where it divides into two terminal branches, named the *perineal nerve* and the *dorsal nerve of the penis*. They will be noticed as they are met with in the dissection of the parts to which they are distributed. It may be well, however, to give a brief description of the course and distribution of the branches of the internal pudic nerve in this place.

The *perineal nerve* accompanies the internal pudic artery as far as a point nearly opposite to the junction of the tuberosity and ramus of the ischium. At this place it perforates the obturator fascia, which up to this point in the perineum separated it from the ischio-rectal fossa, and divides into its two terminal branches. One of these, named the *superficial perineal nerve*, Fig. 195 (2), corresponds to the superficial perineal artery. It is placed in the groove between the erector penis and accelerator urinæ muscles, and is distributed to the scrotum, some of its filaments being continued forwards to the integument covering the under surface of the penis. The *other branch* passes above the transversus perinei muscle and sends filaments to the accelerator urinæ, to the bulb

of the corpus spongiosum, and to the muscles of Wilson and Guthrie.

The perineal nerve, just before it enters the perineum, gives off a branch which has been called the *posterior superficial perineal nerve.* It perforates the great sacro-sciatic ligament, enters the ischio-rectal fossa, and passes forwards to be distributed to the scrotum in the male, and to the vulva in the female. It anastomoses with the inferior hemorrhoidal and the perineal branch of the small sciatic nerve; and sometimes sends branches to the sphincter ani and coccygeus muscles.

The *dorsal nerve of the penis*, instead of perforating the obturator fascia, continues forwards, gets between the layers of the deep perineal fascia, perforates the anterior one, and reaches the dorsum of the penis in company with the artery of the same name. It proceeds forwards to the glans penis, to which it is distributed. It gives off a cutaneous branch which divides into numerous filaments to supply the skin including the prepuce; it also sends off branches which penetrate the substance of the corpus cavernosum. The corresponding nerve of the one last described, in the female, is distributed to the clitoris.

The *small* or *lesser sciatic nerve*, Fig. 192 (6), arises from the lower part of the sacral plexus by one, and sometimes by several nervous cords. It leaves the pelvis at the lower part of the great sacro-sciatic foramen, and beneath the pyriformis muscle. At first it is placed on the inner side of the great sciatic nerve, but soon gets behind it. It divides into *muscular* and *cutaneous branches.* The former supply the gluteus maximus; the latter are divided into the external and internal; they are distributed to the skin on the outer, back and inner parts of the thigh, one or two branches descending as low as the upper part of the leg. Another branch, named the *perineal cutaneous*, or the *inferior long pudendal nerve*, Fig. 218 (4), passes downwards and inwards below the tuber ischii to reach the anterior part of the perineum, where it divides into two branches, which pass forwards, one on each side of the testis, to be distributed to the anterior part of the scrotum, and to the skin on the under part of the penis. It anastomoses with the superficial perineal nerve.

The *great sciatic nerve*, Fig. 192 (7), is the terminal branch of the sacral plexus. It escapes from the pelvis through the

lower part of the great sacro-sciatic foramen; sometimes a portion of it pierces the pyriformis muscle. It will be examined in the dissection of the back part of the pelvis and thigh.

The *sympathetic nerve*, Fig. 142, presents in the pelvis several ganglia and plexuses. The ganglia are placed to the inner side of the anterior sacral foramina. They consist usually of five on each side. The upper one receives one, and sometimes two communicating branches from the last lumbar ganglion. The lower one on each side is connected by a filament to a single ganglion, called the *ganglion impar;* this is situated in front of the coccyx. The ganglia of each side are connected by communicating filaments to the sacral nerves, there being two for each ganglion and its corresponding nerve; they are quite short.

There are two *hypogastric plexuses* in the pelvis, between which there is no direct communication. They are formed by a division of the lumbo-aortic plexus into two, a right and left. They are placed upon the sides of the principal organs in the pelvis, both in the male and female. They receive filaments from several sources in the pelvis, as the sacral ganglia, the inferior mesenteric plexus, and the anterior sacral nerves. Small ganglia are found where the sacral nerves unite with those of the plexus. Each hypogastric plexus gives off several plexuses; they are the following:—

The *vesical* plexus is situated on the side and lower part of the bladder. It sends off two sets of nerves; the *ascending*, which supply the ureters and the upper part of the bladder both in front and behind; and the *horizontal*, which go to the lower part of the bladder, including the neck. Some of these continue over the prostate gland, forming the *prostatic plexus*. From these plexuses small filaments penetrate the structure of the bladder and prostate gland.

From the side of the bladder and the ureter, nerves go to the vas deferens and to the vesicula seminalis, forming a plexus for each one of these organs. From the prostatic plexus nerves proceed to the urethra and to the spongy structure of the penis. They reach the dorsum of the penis by passing through the sub-pubic ligament.

The rectum is supplied by the *superior* and *middle hemorrhoidal plexuses.* The former comes from the inferior mesenteric, the latter from the hypogastric plexus. These plexuses are intimately blended with each other.

An *ovarian plexus* accompanies each of the ovarian arteries from the abdomen; the ovaries receive filaments also from the uterine nerves.

The *uterine nerves* are derived from the hypogastric plexus. They accompany the arteries as they ascend on the lateral borders of the uterus, to supply its fundus anteriorly and posteriorly. From the neck of the uterus nerves proceed to the vagina to form the *vaginal plexus*.

Dissection of the Perineum.

The outlines of the perineal space are indicated by the boundaries of the lower strait of the pelvic cavity. These consist, in front, of the sub-pubic ligament, the descending rami of the pubic bones and the rami of the ischia; laterally, of the tuberosities of the ischia; and behind, of the sacro-sciatic ligaments and the coccyx. The student should make himself perfectly familiar with the exact position of each one of these parts before he attempts the examination of this region; or he should have a ligamentous pelvis before him when he makes his first dissection of the perineum. He should also have a distinct idea of the position and relations of the following parts: The lower part of the rectum, the bladder, the prostate gland, the membranous portion of the urethra, and the deep perineal fascia or triangular ligament through which it passes, the bulbous portion of the corpus spongiosum, the crura of the corpora cavernosa, and the principal muscles in this region. If he cannot acquire this knowledge by reading a description of these parts with the aid of plates, he should make a special dissection of them. No student should expect to obtain a satisfactory knowledge of the anatomy of the perineum by making a single dissection of it. When he has become familiar with the parts enumerated above, he will find that the study of the fasciæ involved in the dissection will be greatly facilitated. He will observe that every reflection or attachment of the fasciæ has a distinct relation to some one or more of these parts; that they are designed to furnish a floor to the cavity of the pelvis, and to fix and keep the parts in their absolute and relative position. It will also be noticed in the progress of the dissection that they form the boundaries of several spaces

which are exceedingly interesting when viewed in reference to the formation of sinuses and abscesses, to effusions of urine, and to the dangers attending operations for the removal of calculi from the bladder, or for any other purpose. The great importance of a knowledge of the anatomy of the perineum should be impressed on the mind of every student independently of the idea of his ever being called upon to operate for calculi in the bladder. Very few in the profession ever have an opportunity to cut for stone, while every physician is liable to meet with cases of sinuses, abscesses, and fistulous openings in this region, which he should be able to treat properly.

To dissect the perineum, the subject must be placed on the back near the end of the table, with a small block under the pelvis. The thighs must be flexed and separated from each other; to keep them in this position, the feet may be fastened by a roller or a cord to the wrists; or a cord may be attached to one of the thighs near the knee, carried under the table and fastened in the same manner to the opposite thigh. If a cord of sufficient length be used, with blocks to support the thighs, the student will have no difficulty in placing and keeping the subject in a favorable position for making his dissection. The rectum should be thoroughly washed out and moderately and evenly distended with tow, cotton, or a piece of a roller gradually introduced into it. The scrotum should be drawn upwards and fastened by hooks.

The first thing to be done in the dissection is to remove the skin. To do this make an incision from the coccyx to the anus, and thence to the raphé of the scrotum; and another from the nates on each side to the anus. In this way the integument may be raised in four flaps. The skin is so thin at the margin of the anus that some care is requisite to raise it and leave the superficial fascia.

The common superficial fascia usually contains a large quantity of adipose substance, especially in the *ischio-rectal fossæ*, spaces situated, one on each side of the anus and lower part of the rectum. This fascia is continuous with the superficial fascia of the parts contiguous to the perineum, and must not be confounded with the *superficial perineal fascia.* To remove it the same incisions may be made as were made to raise the skin. Before doing this, however, the *vessels*

and *nerves* which ramify in it should be observed; also the *boundaries* of the ischio-rectal fossæ.

The *arteries* which supply the perineum are derived principally from the internal pudic, a branch of the internal iliac artery. The course of this artery is deep seated, and will be noticed at an advanced stage of the dissection. The principal branches involved in the removal of the common superficial fascia are the *inferior hemorrhoidal*, Fig. 194 (10). These vary in number from one to three on each side. They pierce a layer of the obturator fascia which covers the internal pudic artery, and pass transversely, or nearly so, across the ischio-rectal fossa to the anus. They supply the lower part of the rectum, including the levator and sphincter ani muscles, and the integument around the anus. They are surrounded by the adipose substance which fills the ischio-rectal fossa. The student cannot be too particular in obtaining an accurate knowledge of the position of these vessels. The subcutaneous branches in the anterior part of the perineum are not of sufficient importance to require any special notice here. They consist of small branches of the *superficial perineal artery*, which is also a branch of the internal pudic, arising from it just after the hemorrhoidal are given off.

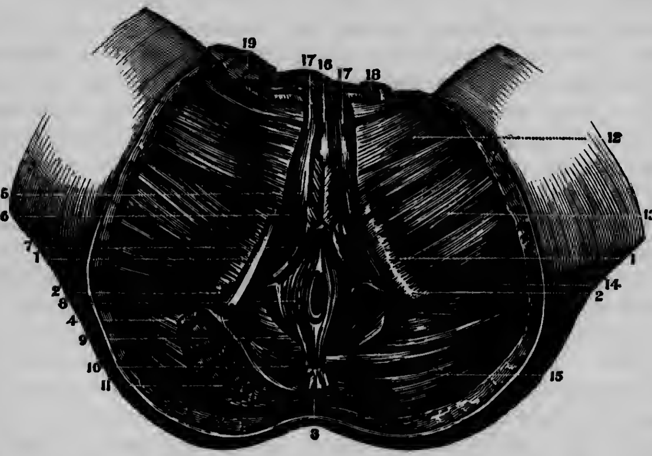
The *veins* correspond to the arteries and require no particular notice.

The *nerves* of the perineum are mainly supplied by the *internal pudic*, which enters this region in company with the internal pudic artery; and its distribution is nearly the same as that of the artery. It sends *hemorrhoidal branches* to the lower part of the rectum, and to the levator and sphincter ani muscles. One of its principal divisions is called the *superficial perineal nerve*, Fig. 195 (2), which passes forwards in company with the superficial perineal artery. In the anterior part of the perineum this nerve becomes subcutaneous and is distributed to the skin in that region and to the scrotum. A *small branch*, derived from the *small sciatic nerve*, is also distributed to the integument of the perineum and scrotum; principally, however, to the latter.

Before examining the boundaries and relations of the ischio-rectal fossæ, the sphincter ani and coccygeus muscles may be studied.

The SPHINCTER ANI, Fig. 193 (8), is *attached*, behind, by tendinous fibres to the coccyx; anteriorly, to the subcutaneous areolar tissue, and to a fibrous structure just in front of the anus, called the *perineal centre*, to which the transversi perinei and the acceleratores urinæ muscles are also attached. It surrounds the lower orifice of the rectum; is narrow and somewhat pointed before and behind this opening, but an inch or more broad on each side of it. It presents an upper and a lower border. The lower one is separated from the skin by a very thin layer of areolar tissue, while the upper one is blended with the fibres of the levator ani. The outer surface is in apposition with the adipose tissue contained in the ischio-rectal fossa. It closes the anus and at the same time slightly elevates it; it also assists the transversi perinei in fixing the perineal centre.

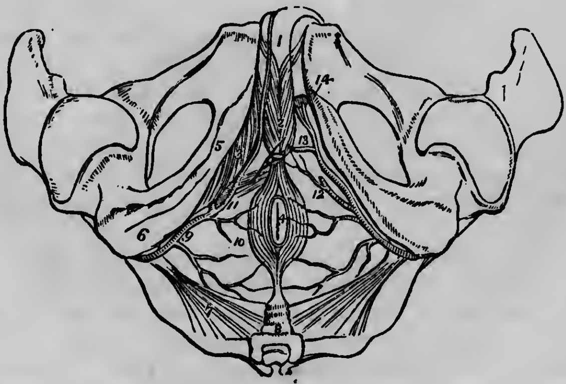
Fig. 193.



A VIEW OF THE MUSCLES OF THE PERINEUM OF THE MALE.—1, 1. Rami of the ischia. 2, 2. Tuberosities of the ischia. 3. Posterior face of the coccyx. 4. Portion of the great sacro-sciatic ligament. 5. Accelerator urinæ. 6. Erector penis. 7. Transversus perinei. 8. Sphincter ani. 9. Levator ani. 10. Musculus coccygeus. 11. Section of the gluteus maximus. 12. Adductor longus. 13. Adductor brevis. 14. Adductor magnus. 15. Gluteus maximus. 16. The urethra. 17, 17. Corpora cavernosa turned up. 18. Spermatic cord turned up. 19. Free extremity of the penis with its integuments.

The COCCYGEUS, Fig. 193 (10), is situated between the pyriformis and the posterior border of the levator ani. It *arises* from the spine of the ischium and from the small sacro-sciatic ligament, and is *inserted* into the side of the coccyx

Fig. 194.



THE ARTERIES OF THE PERINEUM; ON THE RIGHT SIDE THE SUPERFICIAL ARTERIES ARE SEEN, AND ON THE LEFT THE DEEP.—1. The penis, consisting of the corpus spongiosum and corpora cavernosa. The crus penis on the left side is cut through. 2. The acceleratores urinæ muscles, inclosing the bulbous portion of the corpus spongiosum. 3. The erector penis, spread out upon the crus penis of the right side. 4. The anus, surrounded by the sphincter ani muscle. 5. The rami of the ischium and pubes. 6. The tuberosity of the ischium. 7. The small sacro-sciatic ligament attached by its small extremity to the spine of the ischium. 8. The coccyx. 9. The internal pudic artery, crossing the spine of the ischium, and entering the perineum. 10. Inferior hemorrhoidal branches. 11. The superficial perineal artery, giving off a small branch, transverse perineal, upon the transversus perinei muscle. 12. The same artery on the left side out off. 13. The artery of the bulb. 14. The two terminal branches of the internal pudic artery; one is seen entering the divided extremity of the crus penis, the artery of the corpus cavernosum; the other, the dorsalis penis, ascends upon the dorsum of the organ.

and the lower part of the sacrum. It is of a triangular form; and its attachments are aponeurotic. Its inner and upper surface corresponds to the rectum. Its action is to keep the coccyx in its proper place, and to assist in forming the floor of the pelvis.

The ISCHIO-RECTAL FOSSA is wedge-shaped, and is from an inch and a half to two inches deep. The *thin edge* looks upwards and corresponds to the splitting of the pelvic fascia into the levator or anal fascia on the inner side, and the obturator fascia on the outer side. The *base* or *thick edge* looks

downwards, and corresponds to the integument. The *inner* boundary is formed below by the sphincter ani and above by the levator fascia, which covers the levator ani muscle; while the *outer* boundary is formed below by the gluteus maximus, and above by the obturator fascia, which covers the obturator internus muscle. The *anterior* boundary is formed by a reflection of the superficial perineal fascia upwards to join the deep perineal fascia; as the superficial perineal fascia is reflected upwards it is joined to the anterior border of both the obturator and the levator fascia. Thus it will be seen that the ischio-rectal fossa is bounded on three sides by fascia, especially the upper part of it. The *posterior* boundary corresponds to the gluteus maximus and coccygeus muscles, and to the sacro-sciatic ligaments and foramina.

When the contents of the ischio-rectal fossa have been removed and its boundaries carefully observed, the student should endeavor to obtain a distinct idea of its relations to the cavity of the abdomen. He should do this before he has attempted to master the anatomy of that portion of the perineum which belongs to the genito-urinary apparatus. As the ischio-rectal fossa is now fairly exposed, a part of the levator fascia should be carefully removed from the levator muscle. Having done this, a portion of the muscle should also be dissected away when another fascia, the *pelvic*, will be observed. Remove a portion of this and the sub-peritoneal areolar tissue together with the peritoneum itself will be seen. Thus a clear idea of what separates the abdominal cavity from the ischio-rectal fossa will be obtained. It will be seen that, besides the peritoneum and the sub-peritoneal areolar tissue, the bowels are separated from the ischio-rectal fossa simply by the levator ani muscle and the fasciæ that cover its pelvic and perineal surfaces.

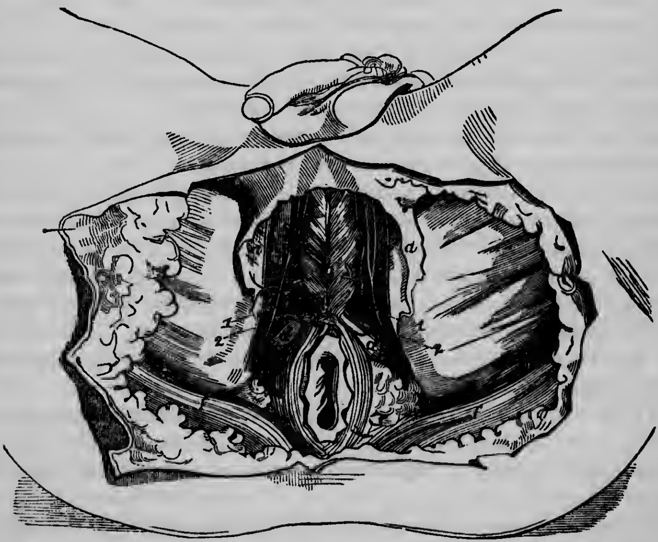
It will now also be observed that the pelvic fascia, Fig. 199 (8), as it descends from the brim of the pelvis, divides into three layers. These are the *obturator* (13), the *levator* or *anal* (15), and the *recto-vesical* (8, 11). The *first* descends on the obturator internus muscle, and is attached below to the ramus and tuberosity of the ischium, and to the great sacro-sciatic ligament; the *second* passes downwards on the perineal surface of the levator muscle to the upper border of the sphincter ani, where it is frequently so thin that it hardly deserves

to be regarded as a distinct fascia; the *third* one, after covering the pelvic surface of the levator, is reflected to the side of the rectum, to the bladder, and the prostate gland. The last-named fascia will be more particularly noticed at another stage of the dissection.

That part of the perineum just dissected belongs essentially to the lower portion of the intestinal canal; while the part that remains to be dissected belongs more particularly to the genito-urinary apparatus. It must be admitted that the latter is more complex and difficult to be examined than the former; and it should be remarked here that, although different fasciæ are spoken of, and have distinct names, they are all continuous with each other, and might be regarded as constituting a single fascia or aponeurosis.

By the different reflections and attachments of the fasciæ, there are formed four principal *cavities* or *pockets*. Two of

Fig. 195.



The Perineum, after the Skin and a Portion of the Superficial Perineal Fascia have been removed.—*a, a.* Superficial perineal fascia. *b.* Acceleratores urinæ. *c, c.* Erectores penis. *d, d.* Transversi perinei. *e.* Upper point of sphincter ani. *f, f.* The edges of the glutei maximi. 1, 1. Superficial perineal arteries. 2, 2. Superficial perineal nerves.

these have already been observed; they contain the levatores ani muscles. The other two, which are situated, one above and the other below the deep perineal fascia, are now to be examined. The *latter* or *lower* one contains, besides some fat and areolar tissue, the superficial perineal vessels and nerves, the erectores penis, acceleratores urinæ, and transversi perinei muscles, and the bulb of the corpus spongiosum; the *former* or *superior* one contains the membranous portion of the urethra, including the muscles of Wilson and Guthrie, the prostate gland, the neck of the bladder, and the vesiculæ seminales.

The lower one is formed by the deep perineal fascia sending off a layer just behind the bulb of the urethra, which passes backwards to the rectum and ischio-rectal fossæ, and then downwards, forming on each side the anterior boundary of the ischio-rectal fossa by uniting with the levator and obturator fasciæ; it is then reflected forwards beneath the transversi perinei muscles and before the anterior portion of the sphincter ani muscle, to be lost in the scrotum and in the superficial fascia on each side of it. The part which is reflected forwards is the *superficial perineal fascia;* it is attached, laterally, to the tuberosities and rami of the ischia, and to the rami of the pubes.

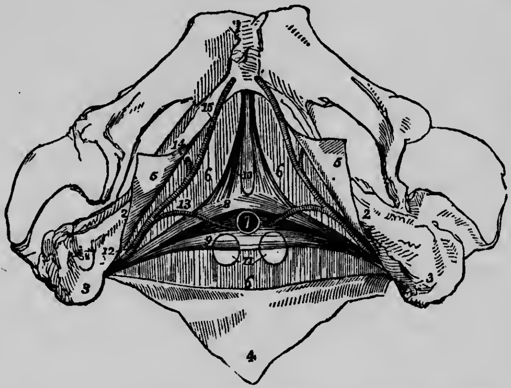
To dissect this space, Fig. 196, two incisions should be made, commencing at a point about two inches and a half in front of the anus and extending them backwards, one to the tuberosity of each ischium or near to the anterior boundary of the ischio-rectal fossa. The fascia included between these two incisions is to be raised and reflected backwards as far as the anus and the ischio-rectal fossæ, but not detached until its connection with the deep perineal fascia has been examined; this cannot be done until the contents of the space inclosed by it and the deep fascia have been dissected. The remaining portions of the fascia are to be reflected laterally, and their attachments to the rami of the ischia and pubes observed. The superficial and transverse perineal vessels and nerves should now be examined.

The *superficial perineal artery*, Fig. 194 (11), enters this space just below the transversus perinei muscle, and passes forwards along the inner border of the erector penis muscle. It is distributed to the perineum and scrotum.

The *transverse perineal artery*, Fig. 194 (11), arises sometimes

from the internal pudic, and sometimes from the preceding artery. It accompanies the transversus perinei muscle to the

Fig. 196.



The Structures contained between the two Layers of the Deep Perineal Fascia.—1. The symphysis pubis. 2, 2. The rami of the pubes and ischia. 3, 3. The tuberosities of the ischia. 4. A triangular portion of the superficial fascia turned down, and shown to be continuous with the deep fascia (6, 6, 6). 5, 5. Two portions of the superficial perineal fascia reflected laterally, showing its connection to the rami of the pubes and ischia. 6, 6, 6. The posterior layer of the deep perineal fascia, the anterior layer having been removed. 7. The membranous portion of the urethra cut across. 8. The superior fasciculus of the compressor urethræ muscle of one side. 9. The inferior layer of the compressor urethræ. The two fasciculi (8) and (9) constitute Guthrie's muscle of one side. 10. The pubic portions of the compressores urethræ, or Wilson's muscles. 11. Cowper's glands, partly embraced by the inferior layer of the compressor urethræ muscle. 12. The internal pudic artery passing anteriorly to the origin of the compressor urethræ. 13. The artery of the bulb. 14. The artery of the corpus cavernosum. 15. The arteria dorsalis penis.

perineal centre, supplying the integument and muscles in front of the anus. The direction of this artery should be particularly observed.

The *nerves* have the same course and distribution as the arteries, which they for the most part accompany.

After removing the vessels and nerves just examined, and also the adipose substance and areolar tissue, of which a considerable quantity is usually found in this space, the following muscles will be exposed and should be carefully studied. A *thin aponeurotic fascia*, which must not be confounded with the superficial perineal fascia, will be found investing

and forming for each of them a sheath; it is connected posteriorly with the deep perineal fascia.

The Erector Penis, Fig. 193 (6), occupies the outer portion of the space. It *arises*, tendinous and fleshy, from the tuberosity and ramus of the ischium and the ramus of the pubes, passes upwards and forwards, and is *inserted* into the corresponding crus of the penis. It draws the crus downwards and backwards, and probably facilitates the erection of the penis.

The Accelerator Urinæ, Fig. 193 (5), is situated to the inner side of the preceding muscle. It *arises* from the perineal centre, and from the raphé which extends forwards in the median line from the centre. Its posterior fibres pass upwards and forwards, embracing the bulb, and are *inserted* into the deep perineal fascia; the middle are *inserted* into a thin tendon above the urethra which is common to the acceleratores muscles; and the anterior fibres *terminate* in a tendinous expansion on the side and dorsum of the penis. Its action is to compress the urethra.

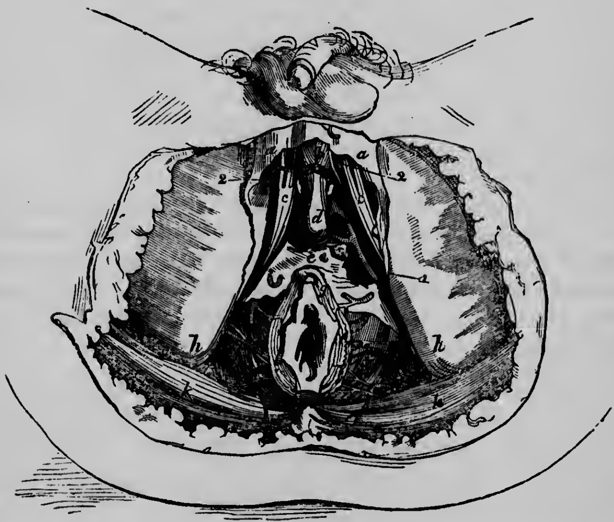
The Transversus Perinei, Fig. 193 (7), is a small muscle which *arises* from the inner side of the tuberosity of the ischium, near the commencement of the origin of the erector penis, and is *inserted* into the perineal centre. It is frequently absent. Its action is to assist in keeping the centre of the perineum fixed; and it may, from the direction of its fibres, tend to draw it slightly upwards and backwards. A fasciculus of fibres is sometimes met with here which has been denominated the *transversus perinei alter*. When present, this small muscle is usually situated deeper than the transversus perinei, being covered in by a thin layer of the deep perineal fascia. It *arises* from the rami of the ischium and pubes, and is *inserted* into the side of the bulb. It is not unusual to find irregular fasciculi of fibres in this space; sometimes apparently belonging to the transversus perinei, and again to the accelerator urinæ, or levator ani.

These muscles may now be raised, but not detached so that they cannot be replaced and viewed with reference to cutting down upon the membranous portion of the urethra. The bulb of the corpus spongiosum should be carefully separated from the perineal centre without destroying the deep perineal fascia at this point. A *triangular space* will

be observed on each side of the bulb, at the bottom of which the triangular ligament or deep perineal fascia will be distinctly seen; by seizing hold of that portion of the superficial perineal fascia which was reflected backwards, and making it tense, its connection with the deep fascia will be made clear. The tendency of urine when it has escaped from the urethra into this space, to pass forwards into the scrotum instead of passing backwards into the ischio-rectal fossæ, will now appear evident.

The *artery of the bulb*, Fig. 194 (13), should now be sought. It arises from the internal pudic between the two layers of the

Fig. 197.



A DEEPER DISSECTION THAN THAT REPRESENTED IN FIG. 195, THE PERINEAL MUSCLES BEING REMOVED AND ALSO THE FAT IN THE ISCHIO-RECTAL FOSSÆ.—*a, a.* Superficial perineal fascia. *b.* Acceleratores urinæ. *c, c.* Crura penis. *d.* The bulb. *e.* Deep perineal fascia. *f, f.* Levatores ani, and inferior hemorrhoidal arteries and nerves. *g.* Sphincter ani. *h, h.* Tuberosities of ischia. *k, k.* Glutei maximi. *. Cowper's gland of the left side, and the artery of the bulb just in front of it. 1. Internal pudic artery. 2, 2. Superficial perineal arteries and nerves.

deep fascia at a point nearly opposite to the bulb. It is readily found by cautiously dividing the layer that covers it at the inner side of the corresponding crus penis and reflecting

it to the bulb. The internal pudic itself may be exposed at the same time in this part of its course; it is partly concealed by the crus, and the ramus of the ischium. The artery of the bulb is distributed to the corpus spongiosum, being directed, after entering it from behind forwards. It will now be seen that this artery, together with the transverse perineal and the inferior hemorrhoidal, has a transverse direction. The transverse perineal is necessarily divided in the lateral operation for stone in the bladder, while the artery of the bulb is avoided by not cutting too far forwards, and the hemorrhoidal by not extending the incision too far backwards in the ischio-rectal fossa. The superficial perineal artery may or may not be cut in this operation. The *position* of the internal pudic may be noticed at this time with reference to the same operation. It will be observed that it lies on the outside of both the ischio-rectal fossa and the triangular space between the bulb and the crus penis, so that, occupying its normal position, it should never be cut in entering the bladder through the perineum.

The arteries of this region are subject to variations as they are in every other part of the body. Instead of one there may be two arteries of the bulb; or this artery may be a branch of some other than the internal pudic. There may be several hemorrhoidal branches, when the one situated anteriorly would almost necessarily be cut in the lateral operation for stone.

The Glands of Cowper, Fig. 197 (*), should now be examined. There are two of them. They are situated, each one just behind and a little below the bulb, being inclined a little to the side of it. Each is about the size of a pea, although they vary much in this respect. They have no proper capsules, but are placed between the two layers of the deep perineal fascia. They will be found by extending the dissection that was made for exposing the artery of the bulb a little deeper and further backwards. They are usually covered below by some fibres belonging to the muscles of Guthrie. Their excretory ducts open into the urethra, as was mentioned in the description of that organ. The student should not be discouraged if he does not find them in his first dissection of these parts. A third gland, situated below the arch of the pubes, and close to Cowper's glands, has been

described, and called the *gland of Litre*, and named by Litre the *anti-prostatic gland*.

Before proceeding to dissect the upper cavity or pocket, it will be well to examine the deep perineal fascia, immediately below the arch of the pubes, and also the levator ani muscle. The first may be done by dividing the corpus spongiosum and the urethra about an inch anterior to the bulb, and dissecting them up as far back as the point where the urethra perforates the fascia. A catheter or bougie should be introduced into the urethra where it has been divided, and carried into the bladder. When this is done, the deep perineal fascia will be seen attached above to the symphysis pubis, laterally to the rami of the pubes; and below, it will be seen perforated by the membranous portion of the urethra. From its shape and structure it has been called the *triangular ligament.* It consists of two layers, separated by the sub-pubic ligament. Only one of these can now be seen. By means of this dense fibrous membrane the urethra, which perforates it about three-fourths of an inch below the symphysis pubis, is at this point firmly fixed in its position. This fact should be carefully observed with reference to the introduction of instruments through the urethra into the bladder.

Before examining the levator ani muscle, the continuity of the deep perineal fascia with the superficial perineal, the obturator, and the levator fasciæ should be attentively studied; also its connection with the perineal centre. Thus far in the dissection no part of these fasciæ has been cut away or destroyed so as to prevent a review of them being made, which is essential to a thorough understanding of them. To examine the levator ani muscle, the lower part of the rectum should be slightly drawn down and pushed to one side, while some portions of the fasciæ just alluded to, including the whole of the levator, must be removed.

The Levator Ani, Fig. 193 (9), is a thin, broad muscle, placed on the side of the lower part of the rectum. Its *origin*, commencing at the symphysis pubis, extends backwards across the obturator foramen to the spine of the ischium. Anteriorly, it arises from the symphysis pubis and from the body of the pubes; posteriorly, from the body and spine of the ischium; the part of the muscle which corresponds to the foramen, arises from the pelvic fascia, where it

splits to form the levator and recto-vesical fasciæ; a white line may be seen from the inside of the pelvis corresponding to this line of separation. As the fibres descend, the entire muscle is inclined obliquely inwards, towards the median line of the perineum. The *insertion* of its fibres extends from the coccyx behind, to the perineal centre in front. Those in the middle part are inserted into the external sphincter and lower part of the rectum; the posterior fibres into the coccyx and a raphé extending from the coccyx to the anus; and the anterior fibres into the perineal centre and the rectum behind the bulb of the urethra. From the origin and insertion of this muscle, it will be seen that its pelvic surface corresponds to the prostate gland, the neck and lower fundus of the bladder, the vesiculæ seminales, and the lower part of the rectum; and that, when both of the muscles act together, they tend to elevate, and at the same time compress, these organs; and, hence, they co-operate with the abdominal muscles in the evacuation of the fæces, the urine, and the contents of the seminal vesicles.

The upper cavity or pocket is formed by a reflection of the two layers of the deep perineal fascia upwards to join the pelvic fascia on the prostate gland and vesiculæ seminales. The muscles of Wilson and Guthrie, or the compressores urethræ, are placed between these two layers so as to inclose the membranous portion of the urethra. These two layers of fascia will be better understood when the muscles just mentioned have been described.

The COMPRESSORES, or LEVATORES URETHRÆ, Fig. 196 (8, 9, 10), are composed of two sets of fibres. Those which compose the muscle of Guthrie *arise* on each side by a short tendon from the ramus of the ischium near where it joins the ramus of the pubes, and, passing transversely inwards, divide into two layers, each of which is *inserted* into a raphé, the one above and the other below the membranous portion of the urethra, extending from the bulb to the prostate gland. Those described by Wilson form on each side a small fasciculus, which *arises* by a narrow tendon from the back part of the symphysis pubis about midway between the anterior ligaments of the bladder and the pubic arch, and, passing downwards, is *inserted* into the muscle of Guthrie. Both of these muscles are fan-shaped, being broader at their insertion

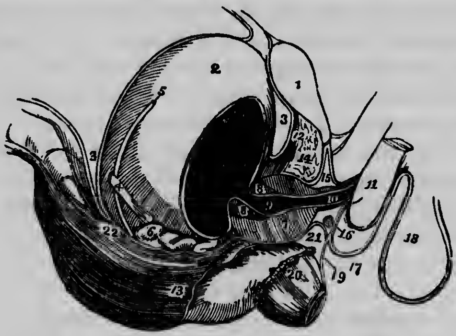
than at their origin. Their fibres are so intermixed with spongy tissue, adipose substance, and bloodvessels, that it is often difficult to obtain a clear and satisfactory view of them; and the difficulty is not unfrequently augmented by the blood that escapes from the vessels which are divided; they are also very feebly developed in some subjects; so that if the student does not succeed, in his first attempt to expose these muscles, in getting so distinct a view of them as he might expect from the description given of them in books, he should not be discouraged. In the whole body there is, perhaps, no other region in the dissection of which so much depends for success upon the character of the subject, as the perineum. If the subject be very fat, or the veins distended with blood, or the muscles pale and feebly developed, it is almost impossible for any one to make a satisfactory dissection or demonstration of the parts found in this region. As the membranous portion of the urethra is placed between the two layers of the muscle of Guthrie, it will be compressed when that muscle contracts; it may also be drawn downwards, which, however, is counteracted by the action of the muscle of Wilson, which tends to draw it upwards. The action of the latter seems to be in part to steady the former. The glands of Cowper are compressed by the lower fibres of the muscles of Guthrie. A thin layer of fascia will be found separating the posterior fibres of the muscle of Guthrie from the anterior fibres of the levator ani. This intermediate fascia is best observed by carefully removing the anterior fasciculi of the levator before the muscle of Guthrie has been disturbed. Like all other intermuscular septa or sheaths of muscles, it varies very much in thickness in different subjects.

Besides the compressores urethræ muscles there will be found surrounding the membranous portion of the urethra an erectile, elastic fibrous tissue, also several veins or a plexus of veins. The dorsal veins of the penis, after perforating the sub-pubic ligament and deep perineal fascia, pass through this region close to the arch of the pubes, Fig. 198 (14), to reach the vesico-prostatic plexus of veins.

Before proceeding further with the dissection upwards, the upper surface of the pelvic fascia must be exposed by the removal of the peritoneum and the subperitoneal areolar tissue; which can be done by partly tearing and partly dissecting them off. That portion of the pelvic fascia which

corresponds to the ischio-rectal fossa was noticed in the examination of that fossa. It was then seen how the levator and obturator fasciæ joined the pelvic; it now remains to be

Fig. 198.

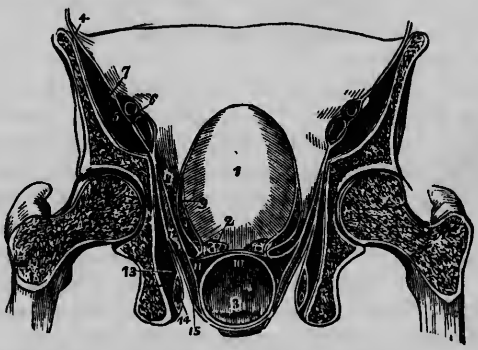


A Side View of the Viscera of the Pelvis, showing the Distribution of the Perineal and Pelvic Fasciæ.—1. The symphysis pubis. 2. The bladder. 3, 3. The recto-vesical fold of peritoneum, passing from the anterior surface of the rectum to the posterior part of the bladder; from the upper part of the fundus of the bladder it is reflected upon the abdominal parietes. 4. The ureter. 5. The vas deferens crossing the direction of the ureter. 6. The vesicula seminalis of the right side. 7, 7. The prostate gland. 8, 8. The section of a ring of elastic tissue encircling the prostatic portion of the urethra at its commencement. 9. The prostatic portion of the urethra. 10. The membranous portion, inclosed by the compressor urethræ muscle. 11. The commencement of the corpus spongiosum penis, the bulb. 12. The anterior ligaments of the bladder. 13. The edge of the pelvic fascia at the point where it is reflected upon the rectum. 14. An interval between the pelvic fascia and deep perineal fascia, occupied by a plexus of veins. 15. The deep perineal fascia; its two layers. 16. Cowper's gland of the right side. 17. The superficial perineal fascia, ascending in front of the root of the penis to become continuous with the dartos of the scrotum (18). 19. The layer of the deep fascia which is prolonged to the rectum. 20. The lower part of the levator ani; its fibres are concealed by the anal fascia. 21. The inferior segment of the funnel-shaped process given off from the posterior layer of the deep perineal fascia, which is continuous with the recto-vesical fascia of Tyrrell. The attachment of this fascia to the recto-vesical fold of peritoneum is seen at 22.

noticed, in the first place, how the two layers of the deep perineal fascia, which are placed, as has been seen, the one above and the other below the muscles of Guthrie, including also the membranous portion of the urethra, *join* the pelvic fascia. This junction takes place around the neck of the bladder, and usually on the sides of the prostate gland just below the neck. If we examine the layer placed above the muscles, we shall find that it joins the pelvic fascia

through the medium of the anterior ligaments of the bladder, which may be regarded as portions of the pelvic fascia. The layer which is placed below the same muscles, after covering their under surface, is reflected to the sides of the prostate gland and the neck of the bladder, where it joins the pelvic fascia just behind the anterior ligaments of the bladder; so that we find three fasciæ or layers of fascia, uniting on the sides of the prostate and the fore part of the neck of the bladder, forming a *conjoined fascia of the pelvic and deep perineal fasciæ.* The lower layer of the deep perineal fascia is not only reflected over the sides of the prostate, but passes upwards over its lower surface, and also over the vesiculæ seminales so as to inclose them.

Fig. 199.



A TRANSVERSE VERTICAL SECTION OF THE PELVIS, SHOWING THE DISTRIBUTION OF THE PELVIC FASCIA.—1. The bladder. 2. The vesicula seminalis of one side, divided across. 3. The rectum. 4. The iliac fascia, covering in the iliacus and psoas muscles (5), and forming a sheath for the external iliac vessels (6). 7. The anterior crural nerve, excluded from the sheath. 8. The pelvic fascia. 9. Its ascending layer, forming the lateral ligament of the bladder of one side, and a sheath to the vesical plexus of veins. 10. The recto-vesical fascia of Tyrrell, formed by the middle layer. 11. The inferior layer surrounding the rectum and meeting at the middle line with the fascia of the opposite side. 12. The levator ani muscle. 13. The obturator internus muscle, covered in by the obturator fascia, which also forms a sheath for the internal pudic vessels and nerve (14). 15. The layer of fascia which invests the under surface of the levator ani muscle, the anal fascia.

The *junction* of the deep perineal and pelvic fasciæ around the prostate gland and neck of the bladder is very important when viewed with reference to cutting into the bladder through the perineum. It is by means of this con-

nection that the cavity of the abdomen is protected against effusions of urine in cutting for stone. The pelvic fascia, where it is reflected from the parietes of the pelvis to join the deep perineal on the sides of the prostate gland and neck of the bladder, forms, together with this fascia, a complete *septum* between the abdominal cavity and the space in which the incision is made in cutting for stone. The pelvic fascia *may* join the deep perineal so low down as to leave hardly space sufficient for making the necessary incision without wounding the fascia where it is covered by peritoneum. We have seen one instance in which it appeared to us that it would be almost impossible to avoid wounding the peritoneum in making an incision sufficiently large to remove an ordinary sized calculus. The higher up the junction between the pelvic and deep perineal fasciæ takes place, the less danger there will be of injury being done to the peritoneum. What are sometimes called the *lateral ligaments of the bladder* are those portions of the pelvic fascia which are reflected from the walls of the pelvis to the sides of the neck of the bladder. They are placed just behind the anterior ligaments. All the fasciæ, or the different layers of fasciæ belonging to the genito-urinary apparatus, and several connected with the lower part of the alimentary canal having now been examined, it will be observed that these fasciæ are not only continuous with each other, but they can be traced from the pelvic fascia commencing above just as well as from the triangular ligament or deep perineal fascia commencing below; and this should be done by the student.

Commencing with the pelvic fascia and tracing it downwards from its origin at the brim of the pelvis, the student, after having dissected the perineum and studied the pelvic viscera, will have little or no difficulty in understanding its connections with other fasciæ, and its relations to the pelvic organs. Anteriorly he will observe the manner in which it is reflected to the neck of the bladder, and to the sides of the prostate gland, forming the anterior and lateral ligaments of the bladder, and also a sheath for the anterior portion of the vesical plexus of veins; also the manner in which it is continuous downwards and forwards with the layers of the deep perineal fascia, as they are placed, one above and the other below the muscles of Wilson and Guthrie. When the attachments of the deep perineal fascia to the arch of the

pubes and the rami of the ischia, and of the pelvic fascia to the brim of the pelvis, and then the manner in which these fasciæ are joined to each other and are connected with the neck of the bladder, the prostate gland, and the membranous portion of the urethra, are observed, it would seem to be impossible for any displacement of these organs to occur. In tracing the middle portion of the pelvic fascia, it will be observed that it is reflected between the rectum and bladder to join the fascia of the opposite side, thus forming what is called the *recto-vesical fascia*, Fig. 199 (10), and behind this, to the sides of the rectum, in the same way as it was anteriorly to the neck of the bladder. The recto-vesical fascia has been called the *fascia of Tyrrell.* It is reflected upwards on the bladder in front, and on the rectum behind, becoming more and more attenuated until it disappears on the parietes of these organs. As it is reflected on the bladder it splits to form a sheath for the posterior part of the vesical plexus of veins, Fig. 199 (9). Below, it is joined by the deep perineal fascia which is continued up behind the prostate gland and the vesiculæ seminales, splitting to form a sheath for the last named bodies, Fig. 199 (2). Where the pelvic fascia is reflected to the rectum, a layer proceeds downwards as far as the insertion of the levator ani muscle, separating this muscle from the rectum; this is continuous anteriorly with the deep perineal fascia behind the prostate gland and vesiculæ seminales.

As the anterior part of the pelvic fascia is continuous with two layers which belong to the perineum, so is the middle portion of it; these are the levator and obturator fasciæ. The levator fascia is given off from the obturator rather than from the pelvic fascia; the continuity, however, remains the same. A line having an antero-posterior direction is observed at or just above the origin of the levator fascia; it is caused by a thickening of the fascia, and gives strength to the upper attachment of the middle portion of the levator ani muscle. When it is remembered that the levator and obturator fasciæ are connected to the layer which joins the deep with the superficial perineal fascia in front of the ischio-rectal fossa, the connection of the two last-named fasciæ with the middle portion of the pelvic fascia will be readily seen.

The posterior part of the pelvic fascia passes behind the

rectum, dividing into two layers; one for the rectum, which is continuous anteriorly with the layers given off from the middle part of the pelvic fascia; the other passes between the sacral plexus of nerves and the branches of the internal iliac vessels, which appear to be furnished with sheaths from this fascia; it is finally lost in dense areolar tissue on the anterior surface of the sacrum. Between the coccygeus and the levator ani muscles the levator fascia is joined to the pelvic by a thin lamina, thus completing the cavity which contains the levator ani muscle.

From the arrangement of the fasciæ or aponeuroses in the perineum and pelvis, the term *perineo-pelvic fascia* might with propriety be applied to them generally. It may be observed that the fascia which arises from the anterior and lateral portions of the brim of the pelvis is continuous all around with those which have their origin from the borders of the lower strait of the pelvis, and that in passing from one border to the other they inclose certain organs so as to keep them *in sitû*, or they send off processes which are attached to the organs contained in the central part of the pelvis.

SECT. IV.—DISSECTION OF THE FEMALE ORGANS OF GENERATION.

The genital organs in the female differ so essentially from the corresponding ones in the male, that a separate examination of them is necessary. It is of the utmost importance that the student, before he commences this dissection, should make himself familiar with the appearance of all the parts within the reach of inspection. The vagina should be carefully cleansed by means of a syringe, and afterwards the finger should be introduced into it, for the purpose of touching the os tincæ *in sitû*, of ascertaining its distance from the exernal orifice of the vagina, and how far the finger must be introduced in order to reach it, so as to be able to judge fairly of its condition. This should be practised after the cavity of the abdomen has been opened, so that the relations of the vagina to that cavity may be observed. The relation that exists between the vagina and the peritoneum is exceedingly important; every student should observe this for himself. The introduction of the speculum into the vagina, and of a

probe or bougie into the os uteri, may be practised in the dissecting-room to considerable advantage. It is, perhaps, equally important to become familiar with the parts involved in carrying an instrument through the urethra into the bladder. The student should observe for himself what points he could rely on to guide him in conducting the catheter to the meatus urinarius, and thence into the bladder. It has happened that through the neglect of acquiring the necessary familiarity with the exact position of the external orifice of the urethra, and its relations to the surrounding parts, the young physician has been subjected to feelings of chagrin and mortification, in consequence of his having failed to introduce the catheter the first time he attempted it in his practice; or if he has not failed, he has been compelled to make an improper exposure of the person of his patient in order to succeed. One or two hours devoted to the examination of these parts, and to the practice of introducing the catheter, in the dissecting-room, will be worth more than all that can be learned from reading books on this subject.

The female organs of generation are divided into the *external* and *internal*. In the latter are included the *uterus*, the *ovaries*, and the *Fallopian tubes;* in the former, the *vagina* and the parts that constitute the VULVA, which are the *mons veneris*, the *labia majora* and *minora*, the *anterior* and *posterior commissures*, the *fourchette*, the *fossa navicularis*, the *clitoris*, the *vestibule*, the *meatus urinarius*, the *hymen*, and the *carunculæ myrtiformes.* All these parts should be carefully inspected *in sitû.*

The MONS VENERIS, Fig. 200 (3), is an eminence placed in front of the symphysis pubis and the pubic bones. It is formed by areolar tissue and adipose substance, situated beneath the integument, which in adult life is covered with hair.

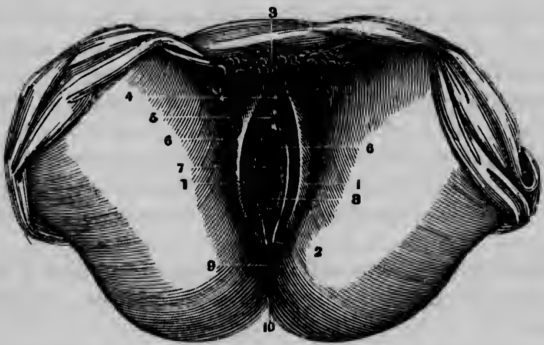
The LABIA MAJORA, Fig. 200 (1, 1), are situated below the mons veneris, one on each side of the *rima*, or the fissure that leads to the vagina. Each consists of a fold of the integument, which contains a substance resembling the dartos in the male, areolar tissue and fat, besides vessels, nerves and sebaceous follicles. Its free border is round, and thicker than its attached border; it is also thicker above than below. Its external surface is continuous with the skin and covered with hair, while its internal surface is continuous

with the mucous membrane of the vagina, so that the skin blends with the mucous membrane on its free border. The *rima* or opening between them has an elliptical form. The labia become exceedingly attenuated during parturition, but very soon recover their natural form and condition. From the quantity of loose areolar tissue which they contain, they are very liable to serous infiltration.

The ANTERIOR and POSTERIOR COMMISSURES are situated, the former at the anterior junction of the labia majores, and the latter, Fig. 201 (6), at their posterior junction. They are merely the extremities of the rima vulvæ.

The FOURCHETTE or FRÆNULUM LABIORUM, Fig. 200 (2), is a small duplicature of the mucous membrane placed a

Fig. 200.



A VIEW OF THE EXTERNAL ORGANS OF GENERATION IN THE VIRGIN—THE VULVA BEING PARTIALLY OPEN.—1, 1. Labia majora. 2. Fourchette. 3. Mons veneris. 4. Prepuce of the clitoris around the glans clitoridis. 5. Vestibule. 6, 6. The nymphæ. 7, 8. The hymen, open in its central portion and surrounding the inferior extremity of the vagina. 9. The perineum. 10. The anus.

short distance behind the posterior commissure. It is frequently lacerated and destroyed during the first parturition.

The FOSSA NAVICULARIS is a small depression situated between the posterior commissure and the fourchette.

The LABIA MINORA or NYMPHÆ, Fig. 200 (6, 6), are folds of the mucous membrane placed within the labia majora. If they be traced from below, they will be found to commence, one on each side, near the middle of the junction

of the labia majora with the vagina and to extend upwards, gradually increasing in size and approaching each other. About three-fourths of an inch below the anterior commissure each one bifurcates, or divides into two folds, an *upper* and a *lower*, which unite in the median line with those of the opposite side. The duplicature formed by the junction of the two upper folds constitutes the *preputium clitoridis*, Fig. 200 (4), while that formed by the two lower joins the glans clitoridis, or the anterior and lower part of the clitoris; it seems to correspond to the frænum of the prepuce of the penis. The nymphæ vary very much in size in different persons; sometimes they are seen projecting beyond the labia majora, and then again they are so small that they can hardly be recognized as distinct bodies. They contain numerous small sebaceous follicles.

The CLITORIS, Fig. 203 (7), corresponds to the penis in the male. It is placed below and in front of the symphysis pubis between the labia majora and above the urethra. It resembles somewhat in its formation the penis. It has two *corpora cavernosa*, which are connected by their *crura* to the rami of the ischia and pubes. It has no corpus spongiosum although it has a *glans*, which is situated on the anterior extremities of the corpora cavernosa; it is composed of erectile tissue.

The corpora cavernosa are formed nearly of the same tissues as the corresponding bodies in the penis. Each crus has a muscle resembling in its origin and insertion the erector penis. It is called the *erector clitoridis*, Fig. 203 (6). The clitoris, also, has a *suspensory ligament*. The clitoris, like the nymphæ, varies greatly in size. It is said to have become very much enlarged under the influence of certain habits, such as constant titillation.

The VESTIBULE, Fig. 200 (5), is a smooth triangular surface, bounded laterally by the nymphæ, below by the meatus urinarius, and above by the inferior folds of the nymphæ. This space should be observed with reference to the introduction of the catheter; for when this surface is found, there will usually be but little difficulty in determining the exact position of the orifice of the urethra.

The MEATUS URINARIUS, Fig. 205 (7), or external orifice of

the urethra is situated in the median line and midway between the nymphæ and just above the upper projecting edge of the vagina. It is surrounded by a slight elevation or ridge formed by the mucous membrane, and, beneath this, by a band of fibres which cause a slight constriction. It is generally closed.

The HYMEN, Fig. 200 (7, 8), consists of a fold of mucous membrane placed at the entrance of the vagina. It varies in shape, being sometimes crescentic with the concavity looking upwards; and, again, consisting of a transverse band with an opening above and below it; or it may form a ring having an opening in the centre with a fringed margin. It may entirely close the external orifice of the vagina so as to prevent the escape of the menstrual discharge. It is very rarely met with in the dissecting-room. Its absence does not afford any certain evidence of the loss of virginity.

The CARUNCULÆ MYRTIFORMES, Fig. 201 (25, 25), are the remains of the hymen. They consist of small reddish bodies attached to the sides and the lower part of the opening into the vagina.

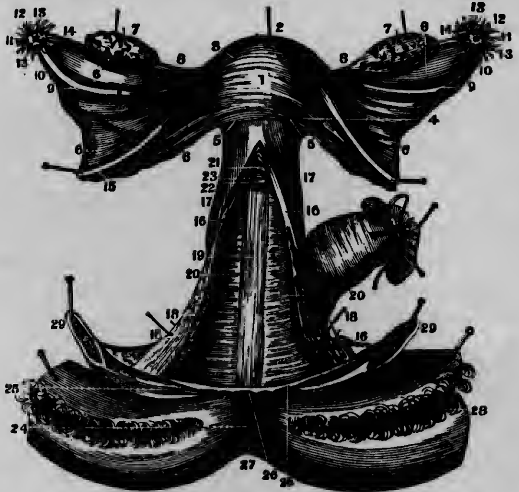
VAGINA.

The VAGINA is placed between the vulva and the uterus, being from four and a half to five and a half inches in length; as it is curved, with the concavity looking forwards, its posterior wall is somewhat longer than the anterior. Its anterior wall corresponds to the bladder and urethra, while the posterior wall corresponds to the cavity of the peritoneum, the rectum, and the perineum. Its axis corresponds to that of the lower part of the pelvis. It is larger above than below; in this respect it is the reverse of the rectum. Its anterior and posterior walls are in apposition, although in drawings they are represented as separated some distance from each other. The cervix of the uterus projects into it at its upper extremity, the posterior lip more than the anterior. This results from its attachment to the uterus being a little higher behind than before.

It is lined by a vascular mucous membrane. Transverse *rugæ* are observed on its upper and lower surfaces. These do not, like the rugæ of mucous membranes generally, disap-

pear when the organ is distended. They are more numerous on the superior than the inferior wall, and are more distinct in the infant than in the adult. There is a longitudinal ridge

Fig. 201.



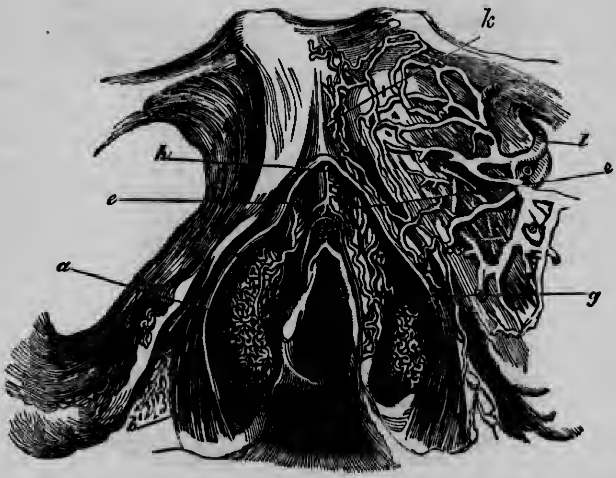
View of the Uterus, Ovaries, Fallopian Tubes, Round Ligaments, Vagina and Vulva—1. Anterior face of the uterus covered by the peritoneum. 2. Its fundus. 3. One of its superior lateral angles near the origin of the Fallopian tubes. 4. Side of the uterus. 5, 5. Its neck embraced by the upper end of the vagina. 6, 6, 6, 6, 6. The broad ligaments. 7, 7. The ovaries drawn up by hooks above their natural position. 8, 8. The ligaments which unite the ovaries to the uterus. 9, 9. Fallopian tubes. 10, 10. Enlargement near their extremities. 11, 11. Their trumpet-shaped mouths. 12, 12. The pavilions. 13, 13, 13, 13. Corpora fimbriata. 14, 14. Portions of the fimbriated processes running to the ovaries. 15. Section of one of the round ligaments. 16, 16, 16, 16. A longitudinal section of the vagina. 17, 17. External surface of the vagina. 18, 18. Its internal anterior parietes. 19. Longitudinal lines forming a sort of raphé on its posterior wall. 20, 20. Transverse wrinkles or folds. 21. Anterior lip of the os uteri. 22. Its posterior lip. 23. Os uteri externum. 24. Perineum. 25, 25. Carunculæ myrtiformes drawn out. 26. Posterior commissure of the vulva forcibly drawn out. 27. The anus. 28. Labium majus everted. 29, 29. The two halves of the clitoris and the labia minora forcibly separated. The rectum, cut off and tied, is seen behind; the bladder and other parts have been removed in front.

in the median line of both the upper and the lower wall. These are named the *columns of the vagina*, Fig. 201 (19). The mucous membrane is covered by a squamous epithelium. It contains numerous follicles and papillæ, especially near its external orifice. It is continued into the uterus above, and

prolonged downwards to be lost in the skin on the labia majora.

Besides the mucous membrane the walls of the vagina contain a layer of erectile tissue inclosed in two quite thick

Fig. 202.



FRONT VIEW OF THE ERECTILE STRUCTURES OF THE EXTERNAL ORGANS OF GENERATION IN THE FEMALE.—*a.* Bulbus vestibuli. *b.* Sphincter vaginæ muscle. *e, e.* Venous plexus. *f.* Glans of the clitoris. *g.* Connecting veins. *h.* Dorsal vein of the clitoris. *k.* Veins going beneath pubes. *l.* The obturator vein.

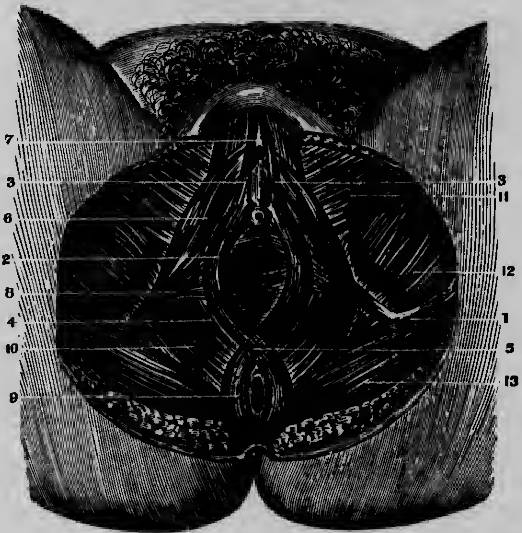
layers of fibrous structure, and outside of these a layer similar to the dartos in the scrotum of the male. The erectile tissue is more abundant near the external orifice than above near the uterus. The *bulbi vestibuli*, Fig. 202 (*a*), are situated, one on each side, at the lower part of the vagina, between it and the nymphæ and vestibule. They are supposed to be analogous to the bulb of the corpus spongiosum of the penis. Each is about an inch in length. They are covered by the mucous membrane.

The anterior wall is thicker than the posterior, especially in the median line, where the urethra is imbedded in it. The peritoneum descends between the rectum and vagina, Fig. 205, so as to cover about one-fourth of the posterior wall of the latter organ. The parietes of the vagina are very

distensible, as is shown in parturition. A part of the fibres of the levatores ani muscles, Fig. 203 (4), are spread out on the sides of the vagina.

The Sphincter Vaginæ Muscle, Fig. 203 (2), surrounds the vagina close to its external orifice. It is exposed by removing the integument from the perineum and labia majora. Its fibres *arise* from the centre of the perineum, and, passing upwards and forwards on the sides of the vagina, are *inserted* into the corpora cavernosa of the clitoris, some fibres passing on to the suspensory ligament. This muscle is narrow at its origin and insertion, but spreads out on the parietes of the vagina. It corresponds to the ejaculator urinæ in the penis. Its action is to constrict the anterior orifice of the vagina. It also compresses the *glands of Bartholine* or the *vulvo-vaginal glands*, two small bodies situated, one on each side, between

Fig. 203.



A View of the Muscles of the Perineum in the Female.—1. Tuber ischii. 2. Sphincter vaginæ. 3, 3. Its insertion into the clitoris. 4. Vaginal ring of the same muscle, which receives a part of the fibres of the levator ani. 5. Intercrossing of the sphincter ani and sphincter vaginæ muscles at the perineal centre. 6. Erector clitoridis. 7. The clitoris, covered by its prepuce. 8. Transversus perinei muscle. 9. Sphincter ani. 10. Levator ani. 11. The gracilis. 12. Adductor magnus. 13. Posterior part of the gluteus maximus.

the vagina and the erector clitoridis. They open by small ducts, about half an inch in length, close to the lateral and posterior carunculæ, by which they are usually concealed.

The vulva is supplied with *arteries* derived principally from the internal and external pudic. The vagina receives branches from the internal pudic and uterine. Besides the *veins* that correspond to the arteries, there are several *plexuses*, belonging both to the vulva and the vagina. Those of the vulva communicate with the vaginal, and these again with the hemorrhoidal. The vaginal are quite large; they are found on both sides of the vagina. The attention of the student should be directed especially to the great vascularity of these parts, and its influence on the pathological condition of them.

The URETHRA, Fig. 205 (6), should be examined in connection with the anterior wall of the vagina. It is from one to one and a half inches in length, and corresponds to the membranous portion of the male urethra. Its direction is downwards and forwards. It is lined by mucous membrane which presents longitudinal folds and mucous crypts. The mucous membrane is surrounded by a layer of spongy erectile tissue, and this again by a muscular layer of circular fibres. Some of the longitudinal fibres of the bladder are prolonged into the walls of the urethra. It is susceptible of considerable dilatation, which greatly facilitates the removal of calculi from the bladder. It is in relation, above, with the crura of the clitoris, with the anterior ligaments of the bladder, and a plexus of veins. It perforates the deep perineal fascia, and also passes between its layers. The muscles of Wilson and Guthrie have the same arrangement as they have in the male.

The *perineum* should be examined with reference to the support it affords to the parts placed above it, and also with reference to parturition. It is wedge-shaped; the thick end or base corresponds to the integument, while the thin end is lost in the recto-vaginal septum.

The *bladder*, Fig. 205 (4), in the female has the same structure as in the male. It differs somewhat in its shape, being usually larger and more globular. This, however, may be owing to pregnancy, and to the habits of the sex, or the circumstances which surround the female. The uvula vesicæ is not quite so large as in the male, which favors the dis-

charge of calculi from the bladder before they have acquired too great a size.

Uterus.

The uterus, Fig. 204, is placed in the upper and central part of the pelvis, between the bladder and the rectum, being inclined forwards in those who have not borne children, so as to form an angle with the vagina. As seen in the dissecting room, it has, perhaps, in a large majority of cases, undergone some displacement, being most frequently inclined backwards. It does not reach the brim of the pelvis, and is frequently observed to be very much below it. A large portion of it is invested by peritoneum, which covers the fundus, the whole of the posterior and the upper three-fourths of the anterior surface, the remaining fourth being in contact with the bladder. The parts covered by the peritoneum present a free surface, which is constantly in apposition with another surface covered by peritoneum. The lower extremity projects into, and is embraced by, the vagina, which is attached to it higher up posteriorly than anteriorly. Each border below the fundus has attached to it the broad ligament which extends, laterally, to the sacro-iliac symphysis, and, with the uterus and the corresponding ligament on the opposite side, divides the pelvic cavity transversely into two *culs-de-sac.* Between the layers which form this fold of peritoneum, are found the round ligament, the ovarian ligament, and the Fallopian tube. The relative position of each of these parts should be noticed. Where they are attached to the uterus the Fallopian tube is placed above the other two, and partly between them, while the ovarian ligament is situated a little lower than the round ligament.

The *round ligament*, or *ligamentum teres*, Fig. 201 (8), passes outwards, upwards, and forwards, to the inguinal canal, through which it passes to reach the mons veneris and the corresponding labium majus, with which it becomes blended. It is surrounded by a layer of peritoneum, which forms what is called the *canal of Nuck.* It is composed of a venous plexus, of arteries, of a plexus of nerves, and of muscular fibres. Its use is said to be to support the uterus, and to assist in keeping it in the axis of the pelvic cavity. It is very evident, from its size and structure, that it cannot con-

tribute much, if any, to this purpose. It may place in direct sympathetic relation the uterus with the external organs.

The *ovarian ligament* Fig. 204 (*p*), is about two inches in length. It is composed of fibro-muscular tissue, and passes outwards to be inserted into the ovary. It retains the ovary *in sitû.*

The *Fallopian tube*, Fig. 204 (*s*), extends laterally towards the brim of the pelvis. It is from four to five or six inches

Fig. 204.

POSTERIOR VIEW OF THE UTERUS AND ITS APPENDAGES, THE CAVITY OF THE UTERUS BEING SHOWN BY THE REMOVAL OF ITS POSTERIOR WALL, AND THE VAGINA BEING LAID OPEN.—*a*. Fundus, *b*, body, and *c*, cervix of the uterus laid open. The arbor vitæ is shown in the cervix; at the constriction just above it is the os uteri internum. *d*. The os uteri externum. *e*. The interior of the upper part of the vagina. *f*. Section of the walls of the uterus. *i*. Opening into right Fallopian tube. *o, o*. Ovaries. *p, p*. Ligaments of ovaries. *r*. Broad ligament. *s, s*. Fallopian tubes. *t, t*. Fimbriated extremities.

long; placed in the upper border of the broad ligament, it forms a curve with the concavity looking downwards and a little backwards. Its free extremity is usually observed close to the ovary. When this is examined, it will be found to present a fimbriated arrangement; this is best seen when it is allowed to float in water. It is also expanded or funnel-shaped, which enables it to grasp a part of the ovary, and to receive with greater certainty the ovum which is about to escape from that body. This end of it has been named the *corpus fimbriatum*, Fig. 204 (*t*), and also the *morsus diaboli*. The Fallopian tube is composed of a *serous* or *peritoneal*, a *muscular* and a *mucous layer*. The mucous membrane is con-

tinuous at the uterine orifice with the lining membrane of the uterus, and is blended at its free extremity with the peritoneum. It affords the only instance in the body where a mucous and serous membrane are continuous, or where a serous cavity has an external communication. It is covered with ciliated and columnar epithelia; it also presents longitudinal rugæ or plicæ. The muscular layer is a prolongation of the muscular tissue of the uterus. It consists of a longitudinal and circular set of fibres. The uterine orifice will be seen when the cavity of the uterus is exposed. The fimbriæ are very frequently met with more or less obliterated by adhesions to each other, or to the surrounding parts.

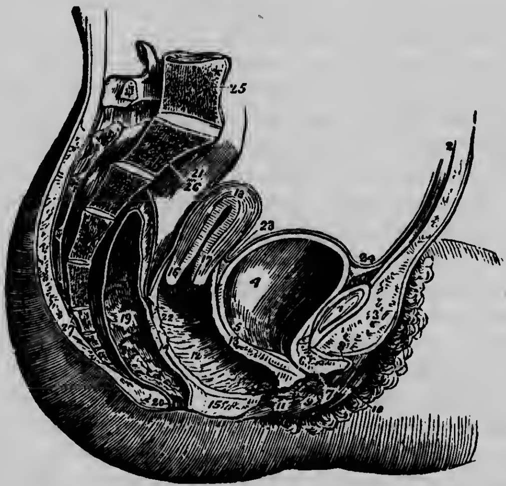
The uterus varies in size, and hence its dimensions vary as given by different writers. It is usually from two inches and a half to three inches in length, an inch and a half to two inches in breadth, and about three-fourths of an inch thick. In women who have borne children it is larger than in those who never have. It is divided into the *fundus*, *body*, and *cervix*. The fundus, Fig. 204 (*a*), is the part above the attachments of the Fallopian tubes; the cervix, Fig. 204 (*c*), is the lower part, being separated from the *body*, Fig. 204 (*b*), or the portion between the fundus and cervix, by a slight constriction. Its weight varies from one to two ounces, according as it varies in size.

In form, it resembles a pear flattened on two sides, being a little more convex posteriorly than anteriorly. The cervix is constricted at both ends, being shaped like a wine-cask. The part that projects into the vagina is divided by a transverse fissure into an anterior and a posterior lip. The latter is not quite so thick as the former, but appears, when examined *in sitû*, to be a little more prominent, or to project a little more than the former, which is owing to the vagina being inserted higher on the cervix behind than in front. The vaginal orifice has been called the *os uteri*, *os uteri externum*, or *os tincæ*, Fig. 204 (*d*), from a fancied resemblance it has to the mouth of the tench fish.

It is exceedingly important that the student should obtain a correct idea of the cervix of the uterus when in a perfectly healthy state, in order that he may be able to detect any deviation from a strictly physiological condition. The time has been when a student could graduate in a respectable institution without feeling that he might be required at a

very early period, or perhaps at any period in his practice, to inspect the cervix of the womb, and determine its condition in regard to health or disease. No one, however, can do this at the present time without proving false to himself and to those who shall confide in his professional skill. Drawings prepared by the most skilful artists may be within his reach, but they alone should not satisfy his desire for accurate knowledge. They may be invaluable as aids, but should never be relied on exclusively as substitutes for nature. Is there not just reason to apprehend that the vis-

Fig. 205.



A Vertical Section of the Female Pelvis and Viscera.—1. The symphysis pubis, to the upper part of which the tendon of the rectus muscle is attached. 2. The abdominal parietes. 3. The collection of fat, forming the projection of the mons veneris. 4. The urinary bladder. 5. The entrance of the left ureter. 6. The canal of the urethra, converted into a mere fissure by the contraction of its walls. 7. The meatus urinarius. 8. The clitoris, with its præputium, divided through the middle. 9. The left nympha. 10. The left labium majus. 11. The meatus of the vagina, narrowed by the contraction of its sphincter. 12. The canal of the vagina, upon which the transverse rugæ are apparent. 13. The thick wall of separation between the base of the bladder and the vagina. 14. The wall of separation between the vagina and rectum. 15. The perineum. 16. The os uteri. 17. Cervix uteri. 18. The fundus uteri. The cavity of the uterus is seen in the centre of the organ. 19. The rectum, showing the disposition of its mucous membrane. 20. The anus. 21. The upper part of the rectum, invested by the peritoneum. 22. The recto-uterine fold of the peritoneum. 23. The utero-vesical fold. 24. The reflection of the peritoneum, from the apex of the bladder, upon the urachus, to the internal surface of the abdominal parietes. 25. The last lumbar vertebra. 26. The sacrum. 27. The coccyx.

cera contained in the pelvis receive altogether too small a share of the attention of the student in the dissecting-room, the *only* place where a proper knowledge of them can be acquired?

The cavity of the uterus may be exposed by simply making a vertical incision through its parietes, and forcibly separating the cut edges, or it may be done by making a transverse vertical incision, so as to divide it into two equal parts, one being the anterior and the other the posterior half. The walls of the uterine cavity vary in thickness at different points. Where the Fallopian tubes join them, they are not more than two or three lines thick; the anterior and posterior walls are from four to six lines thick; the walls of the cervix are not so thick as those of the body. Like the vaginal, the anterior and posterior surfaces of the uterine cavity are constantly in apposition. Owing to the great thickness of the walls, the cavity is comparatively very small. It has the shape of a curvilinear triangle, the superior angles corresponding to the mouths of the Fallopian tubes, and the lower angle to the *os uteri internum*, or *isthmus uteri*, Fig. 204 (*c*), the opening between the body and the cervix, or, if the latter be included, the os externum. The mucous membrane is very thin and delicate, so much so that its existence has been denied or doubted by some. It is more vascular in the body than in the cervix, especially during the menstrual period. In the cervix, a vertical ridge or column is observed in the median line both on the anterior and posterior wall, from which proceed other ridges at an obtuse angle. The term *arbor vitæ uterina*, Fig. 204 (*c*), has been employed to designate this appearance. It commonly becomes less apparent after the first parturition, although not necessarily so. Numerous follicles may be noticed in the cervix, especially near its external os, and some in the body. They have been named the *ovula of Naboth* from the circumstance that Naboth happened to observe them in a diseased condition, and thinking they were ovula, described them as such.

The openings that lead into the Fallopian tubes, Fig. 204 (*i*), are so small that they are scarcely perceptible to the naked eye. The cavity is elongated towards them so as to form cornua.

The muscular coat of the uterus is hard, dense, and of a grayish color. It consists of fibres, which, in the unimpregnated uterus, cannot be traced on account of their compact-

ness and interlacing apparently in every direction. They are non-striated, and hence belong to those of organic life. They are arranged in the body in a superficial and a deep-seated layer. Anteriorly and posteriorly the *superficial* have a longitudinal direction; laterally they are oblique, and are prolonged into the round and ovarian ligaments, and into the walls of the Fallopian tubes. The *deep-seated* are arranged in the form of two hollow cones, the bases of which correspond to the median line, interlacing with the fibres of the opposite side, while the apices surround the cornua, and extend into the Fallopian tubes and the round and ovarian ligaments. The cervical portion of the muscular coat consists of circular fibres which interlace and cross each other.

The Ovaries.

The *ovaries*, Fig. 204 (*o*), are the analogues in the female, of the testes in the male. There are two of them, one on each side. Each is placed between the layers of the broad ligament, behind the Fallopian tube, and about two inches from the uterus, to which it is connected by the round and broad ligaments. It is a small oval body flattened on the sides from before backwards. They increase in size during pregnancy, and like the testicles, become atrophied in old age. Their anterior, posterior, and upper surfaces are free. One or more of the fimbriæ are usually attached to their outer extremities. Immediately under the peritoneum is a thick, dense, fibrous coat, corresponding to the tunica albuginea of the testicle. The peritoneum adheres to this in the same manner as the tunica vaginalis testis adheres to the testicle. From the inner surface fibrous bands are sent inwards into a cellulo-vascular substance named the *stroma.* Besides the fibrous and serous coats there is a vascular one, similar to the tunica vasculosa of the testicle. Throughout the stroma are distributed the *Graafian vesicles;* they vary very much in size and number. They can be best observed just after parturition, when the ovaries are soft and swollen. Each vesicle consists of two coats, an external and internal, and contains a yellowish fluid and an ovum. When a vesicle ruptures, and the ovum escapes, the remains of the vesicle, it it is supposed, forms a brownish-yellow body called *corpus luteum.*

The *vessels* and *nerves* of the uterus and ovaries are noticed in the dissection of the vessels and nerves of the pelvic cavity.

CHAPTER II.

OF THE LOWER EXTREMITY.

SECT. I.—DISSECTION OF THE ANTERIOR PART OF THE THIGH.

THE position and connections of the parts concerned in femoral or crural hernia are such that the examination of them naturally precedes the general dissection of the anterior part of the thigh; hence it will be unnecessary to describe again the parts which have been examined specially as well as in their relations to femoral hernia.

ANATOMY OF FEMORAL HERNIA.

In *femoral* or *crural hernia* the bowel protrudes under Poupart's ligament, near its insertion into the spine and crest of the pubic bone. The parts which are involved in this form of hernia are situated below, behind, and above Poupart's ligament. Those below it are the skin, the superficial fascia including the vessels, nerves, and lymphatics which are found in it, the fascia lata and the infundibuliform sheath of the femoral artery and vein; behind it are found the psoas magnus and iliacus internus muscles, the anterior crural nerve, the external iliac artery and vein, the infundibuliform sheath, and the femoral ring; above it and in the abdomen are the peritoneum, the sub-peritoneal areolar tissue, and the fasciæ transversalis and iliaca.

The parts in the thigh below Poupart's ligament can be exposed without opening the cavity of the abdomen; but the dissection of the parts placed behind and above it, require this cavity to be opened. The integument must be dissected off from the anterior portion of the upper third of the thigh. This may be done by making an incision through the skin, from the anterior superior spinous process of the ilium, directly downwards to the middle third of the thigh, and then extending it transversely across to the inner side of

Fig. 206.

the thigh. It is supposed that the parts in the inguinal region have already been dissected, so that no new incisions will be required above Poupart's ligament.

Having exposed the superficial fascia, the student should now look for the subcutaneous vessels, nerves, and lymphatic glands in this region.

The *arteries* are the arteria ad cutem abdominis, the external circumflex ilii, the superficial external pudic, and the inguinal branches. They all arise a short distance below Poupart's ligament; sometimes two or three of them arise by a common trunk.

The *arteria ad cutem abdominis*, or *superficial epigastric*, Fig. 206 (2), passes upwards and inwards over Poupart's ligament, in the direction of the umbilicus. It is distributed to the integument.

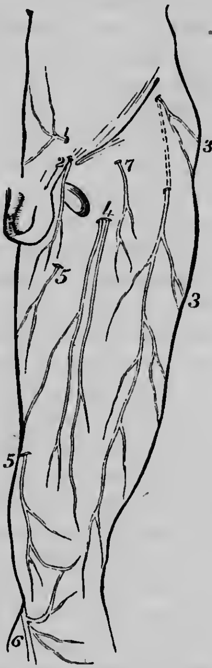
The *superior external pudic*, Fig. 206 (16), goes inwards to supply the integument on the pubes, the penis, and the scrotum.

The *external circumflex ilii*, Fig. 206 (15), passes outwards towards the anterior superior spinous process of the

A VIEW OF THE ANTERIOR AND INNER ASPECT OF THE THIGH, SHOWING THE COURSE AND BRANCHES OF THE FEMORAL ARTERY.—1. The lower part of the aponeurosis of the external oblique muscle; its inferior margin is Poupart's ligament. 2. The external abdominal ring. 3, 3. The upper and lower parts of the sartorius muscle; its middle portion having been removed. 4. The rectus. 5. The vastus internus. 6. The patella. 7. The iliacus and psoas; the latter being nearest the artery. 8. The pectineus. 9. The adductor longus. 10. The tendinous canal for the femoral artery formed by the adductor magnus and vastus internus muscles. 11. The adductor magnus. 12. The gracilis. 13. The tendon of the semi-tendinosus. 14. The femoral artery. 15. The external circumflex ilii artery taking its course along the line of Poupart's ligament, to the crest of the ilium. 2. The superficial epigastric artery. 16. The two external pudic arteries, superior and inferior. 17. The profunda artery giving off 18, its external circumflex branch; and lower down the three perforantes. A small portion of the internal circumflex artery (8) is seen behind the inner margin of the femoral, just below the deep external pudic artery. 19. The anastomotica magna, descending to the knee, upon which it ramifies (6).

ilium, where it is lost in the integument. The *inguinal branches* supply the lymph-

Fig. 207.



Plan of the Cutaneous Nerves on the Front of the Thigh.—1, 2. Branches of the superior and middle musculo-cutaneous nerves. 3, 3. Branches of external cutaneous nerve. 4. Branches of middle cutaneous nerve. 5, 5. Internal cutaneous; the lower number refers to the anterior division of this nerve. 6. Long or internal saphenous nerve, when become subcutaneous. 7. Crural branch of the genito-crural nerve.

atic glands and areolar tissue in this region.

The *principal vein* is the *internal saphenous*, Fig. 208. This is situated on

Fig. 208.

Saphenous Opening in the Fascia Lata, Internal Saphenous Vein, &c—1. Saphenous opening. *a.* External epigastric vein. *b.* External pudic vein. *c.* Superficial circumflex ilii. *d.* Beginning of external saphenous vein.

the inner and anterior part of the thigh, and lies close to the fascia lata. It receives several branches, Fig. 207 (*a*, *b*, *c*), some of which accompany the arteries already described.

The *nerves* (Fig. 207) are derived from the lumbar plexus, the genito-crural, and the anterior crural. They penetrate the fascia lata obliquely at different points, and after running some distance they leave it to become subcutaneous. The integument on the upper and anterior part of the thigh is supplied principally by three branches. One of them, a *branch* of the *superior musculo-cutaneous*, reaches the thigh through the external abdominal ring; another one, a *branch* of the *genito-crural*, passes through the fascia lata just below the middle of Poupart's ligament; the third one, a *branch* of the *inferior musculo-cutaneous* or the *external cutaneous nerve*, pierces the fascia below the anterior superior spinous process of the ilium. The middle cutaneous nerve sometimes becomes subcutaneous near the junction of the upper with the middle third of the thigh, but usually lower down. Very little importance is attached to these nerves in connection with the anatomy of femoral hernia.

The *lymphatic glands*, Fig. 148 (7), are divided into the *deep* and *superficial;* the *former* are placed beneath the fascia lata, and the *latter* are imbedded in the superficial fascia. The superficial are again divided into the *superior* and *inferior;* the superior lie along Poupart's ligament, some above and others below it; the inferior are situated near the saphenous vein. These glands are frequently found enlarged, so that the student can often get in his dissection a distinct view of their location. They vary in number in different subjects; sometimes several are joined together. The superficial lymphatics of the penis pass through the glands situated near Poupart's ligament, and hence the liability of these to become affected in venereal disease.

The superficial fascia should now be removed. It may be raised and reflected in the same manner as the skin was; or it may be turned off from above downwards and from within outwards. The saphenous vein must be dissected out as far up as where it enters the saphenous opening, cutting it across below but not above, as its connection with the infundibuliform sheath of the femoral vessels should be, for the present, preserved. In raising the superficial fascia in front of and around the saphenous opening, it will be found to

contain more or less fibrous tissue which connects it firmly to the fascia lata, especially to the surface of the falciform process and its crescentic border. Sometimes this connection between the two fasciæ is so intimate that in separating them it seems more like making an artificial division than following any natural line of separation. On account of its fibrous character, its close connection to the fascia lata, and the numerous small openings in it for the transmission of lymphatics, this part of the superficial fascia has been described as a distinct fascia, under the name of *cribriform fascia.* There is no good reason, however, why it should be so regarded or described.

To raise the superficial fascia in any part of the femoral region without getting through the fascia lata requires a good deal of care, and more particularly if the subject happens to be fat. No student should attempt to remove it with the expectation of preserving the subjacent parts entire unless he has previously obtained a clear idea of them from books or previous demonstrations. The parts which require the most care not to injure in the dissection are, the falciform process in front of the femoral vessels, its crescentic border, Hey's ligament, and the infundibuliform sheath where it corresponds to the saphenous opening, and is perforated by the saphenous vein. In his first dissection of this region, the student had better remove the superficial fascia corresponding to these parts piecemeal.

The *fascia lata*, Fig. 150 (17), Fig. 208, is the proper investing membrane of the thigh. It is aponeurotic in structure, resembling in some parts a broad tendon. It forms a common sheath to the muscles of the thigh, and furnishes septa which pass between them and separate them from each other. It will be referred to from time to time as the dissection of the thigh is continued. In the region which is now being examined, it constitutes a most important feature in the anatomy of femoral hernia. An opening occurs in it just below the inner portion of Poupart's ligament, through which the internal saphenous vein passes to open into the femoral vein, and through which the bowel escapes in femoral hernia. This orifice is named the *saphenous opening*, Fig. 148 (20). The manner in which it is formed is a little complex; or, it is apt to appear so to the student.

In describing this portion of the fascia lata, it must be pre-

sumed that the dissector has some knowledge of the muscles and vessels situated beneath it, also of Poupart's ligament including Gimbernat's, and of the infundibuliform sheath of the vessels.

It is divided into two parts, by the saphenous opening. The portion which is situated on the inner side of the opening is named the *pubic* or *pectineal*, and, that placed on the outer side and above, the *sartorial* or *iliac* portion. Below the opening the fascia is continuous from one side of the thigh to the other.

The *pubic* portion is usually quite thin, and lies directly on the adductor longus and pectineus muscles. It is attached, above, to the body, the spine, and the pectineal line of the pubic bone; externally, it dips down behind the infundibuliform sheath, and of course behind the femoral vein and artery which the sheath incloses.

The *iliac* portion lies on the sartorius, iliacus internus and psoas magnus muscles, and the infundibuliform sheath with its inclosed vessels, and in front of the femoral ring. It is attached, above, to the anterior superior spinous process of the ilium, and to the lower border of the whole of Poupart's ligament, including Gimbernat's. Internally, it forms the outer and upper boundary of the saphenous opening. This border is curved with the concavity looking to the pubic side and somewhat downwards; the term *crescentic* has been applied to it.

That portion of the fascia which lies in front of the vessels and the femoral ring is named the *falciform process*, while that portion of the process which is placed in front of the ring is called *Hey's ligament*. Hey's ligament, then, is understood to be, simply the small portion of the fascia lata which lies in front of the femoral ring and is attached to the border of Gimbernat's ligament, and, by a narrow point, to the pectineal line.

It will now be seen that the infundibuliform sheath and the femoral vessels lie *behind* the iliac and *in front* of the pubic portion of the fascia lata; and that the saphenous opening *is formed* by the division of the fascia lata into these two portions.

The *saphenous opening*, Fig. 148 (20), is of an oval form with the narrow extremity directed upwards. The *lower* boundary is named the *semilunar margin*, and is formed by a

doubling of the fascia on itself; it is easily found by tracing the saphenous vein upwards. The *outer* and *upper* boundary is formed by the crescentic border of the falciform process. This does not always present a well-defined margin. It may usually be found by drawing the semilunar margin downwards with the forceps or tenaculum, and thus making it tense. The *inner* boundary is formed by the external surface of the pectineal portion of the fascia.

In dissecting the saphenous opening, the student must bear in mind that the femoral vessels are not to be exposed, as it would destroy the infundibuliform sheath which has not yet been examined. The saphenous vein perforates the sheath, and hence it should not be traced at this stage of the dissection further than to the saphenous opening.

The parts in the abdomen should now be examined. As they have already been described in detail in connection with the other parts of the abdomen, it will only be necessary to notice them now in their relations to hernia. They consist of the peritoneum, the subperitoneal areolar tissue, and the fasciæ transversalis and iliaca.

The *peritoneum* is the most internal layer, lying next to the bowels. It presents a depression or fossa bounded, on the outer side, by a fold caused by the remains of the umbilical artery of the fœtus projecting inwards, and below by the horizontal ramus of the pubic bone. This fossa corresponds to the femoral ring.

The *subperitoneal areolar tissue* is placed between the peritoneum and the fasciæ transversalis and iliaca. It connects the peritoneum and these fasciæ, and contains the epigastric, the spermatic, and the external iliac vessels, also the vas deferens, the genito-crural nerve, and lymphatics. It is not equally diffused between these membranes, but is more abundant in some places than in others. It, together with a lymphatic gland, fills the crural canal; this part of it forms what has improperly been called the *septum crurale.* This tissue is always carried down by the bowel in hernia, and is then converted into a well-marked membranous layer which has been designated the *fascia propria.* This should now be carefully dissected off from the fasciæ and the other parts beneath it. It will then be seen that the transversalis and iliac fasciæ are united along Poupart's ligament from the anterior superior spinous process of the ilium to near the external

iliac artery, thus, closing the space between the ligament and the iliacus internus and psoas magnus muscles; but between the point where the junction of the two fasciæ ceases on Poupart's ligament and the spine of the pubic bone, or rather Gimbernat's ligament, a large opening is observed between Poupart's ligament in front and the os pubis behind. Instead of the fasciæ, however, terminating at the margin of

Fig. 209.

A Section of the Structures which pass beneath the Femoral Arch.—1. Poupart's ligament. 2, 2. The iliac portion of the fascia lata, attached along the margin of the crest of the ilium, and along Poupart's ligament, as far as the spine of the os pubis (3). 4. The pubic portion of the fascia lata, continuous at (3) with the iliac portion, and passing outwards behind the sheath of the femoral vessels to its outer border at 5, where it divides into two layers; one is continuous with the sheath of the psoas (6) and iliacus (7); the other (8) is lost upon the capsule of the hip-joint (9). 10. The anterior crural nerve, inclosed in the sheath of the psoas and iliacus. 11. Gimbernat's ligament. 12. The femoral ring, within the femoral sheath. 13. The femoral vein. 14. The femoral artery: the two vessels and the ring are surrounded by the femoral sheath, and thin septa are sent between the anterior and posterior wall of the sheath, dividing the artery from the vein, and the vein from the femoral ring.

this opening, they are prolonged downwards to the extent of about an inch and a half, forming a sort of a *pouch* open at the lower end for the passage of the femoral vessels. This pouch is divided lengthwise into three compartments or canals, Fig. 209 (14), by *two fibrous septa* which pass from its anterior to its posterior wall. The external iliac artery passes through

the *outer*, and the external iliac vein the *middle* one, while the *inner* one, which is shorter than the other two, is occupied by *subperitoneal areolar* tissue and a lymphatic gland, and is named the *crural canal.* The pouch itself is the *infundibuliform sheath* of the femoral vessels, noticed in the dissection of the parts below Poupart's ligament.

The *crural canal* should now be examined. To do this, the areolar tissue and lymphatic gland, if one be present, must, in the first place, be removed; the finger should then be introduced into, and gently pushed down to the saphenous opening, having first flexed the thigh on the abdomen and rotated it inwards. If the thigh be now extended and rotated outwards, the upper part of the canal will be constricted by Poupart's and Hey's ligaments being made tense, and the effect of the position of the limb upon the neck of a hernial tumor distinctly understood, as well as the importance of placing the limb in a proper position when attempting to return the bowel either by taxis or after an operation in case of strangulation.

The upper orifice of the crural canal is called the *crural* or *femoral ring*, Fig. 209 (12). Its *boundaries* are, in front and on the inner side, Hey's ligament and Poupart's including Gimbernat's ligament; on the outer side, the femoral vein; and behind, the pubic bone covered by a lamina of fibrous tissue. These boundaries are exterior to the proper walls of the canal. Dropping the terms of Hey's ligament and Gimbernat's ligament, it might simply be said that the fascia lata and Poupart's ligament are placed in front and on the inner side of the upper part of the crural canal, and must be regarded, when considered in their relations to the neck of a hernial tumor, as forming one structure. The crural canal cannot be said to have any external orifice, unless the saphenous vein forms one in entering the sheath of the vessels.

There is no artery of much size in the majority of cases that has any direct relation to the femoral ring. There is usually a small anastomosing branch which crosses over the ring to the obturator artery. This *branch* is occasionally met with of considerable size. The *obturator artery* not unfrequently arises from either the epigastric or external iliac, and passes inwards to reach the upper part of the obturator foramen. In this case it may be placed either above or below the neck of a hernial tumor; but, if it arises from the

iliac artery, some distance above Poupart's ligament, it will have no direct relation to hernia.

The transversalis and iliac fasciæ may now be dissected up

Fig. 210.

After the removal of the Lower Part of the External Oblique (with the exception of a small slip including Poupart's Ligament), the Lower Portion of the Internal Oblique was raised, and thereby the Transversalis Muscle and Fascia have been brought into view. The Femoral Artery and Vein are seen to a small extent, the Fascia Lata having been turned aside and the Sheath of the Bloodvessels laid open.—1. External oblique muscle. 2. Internal oblique. 2′. Part of same turned up. 3. Transversalis muscle. Upon the last-named muscle is seen a branch of the internal circumflex ilii artery, with its companion veins; and some ascending tendinous fibres are seen over the conjoined tendon of the two last-named muscles. 4. Transversalis fascia. 5. Spermatic cord covered with the infundibuliform fascia from preceding. 6. Upper angle of the iliac part of fascia lata. 7. The sheath of the femoral vessels. 8. Femoral artery. 9. Femoral vein. 10. Saphenous vein. 11. A vein joining it.

for a short distance above the mouth of the infundibuliform sheath in order to trace them down as they enter into the formation of this sheath. In doing this, the fascia transversalis will be found to be intimately connected to some apo-

neurotic or tendinous fibres which arise to the outer side of the artery, and, arching over the mouth of the sheath, are inserted into the linea pectinea; these fibres form what has been called the *deep femoral arch.* When observed from above they appear, in front of the sheath, to be a part of Poupart's ligament. When the fascia has been separated from these fibres, the handle of the scalpel can generally be carried down beneath them to the saphenous opening, and also to the outer side of it, so as to separate the falciform process of the fascia lata from the sheath. The parts in front of the sheath may next be divided and reflected off for the purpose of examining the sheath with its septa, and the artery and vein as they lie in it. The *anterior crural nerve*, Fig. 209 (10), will be found four or five lines external to the artery, occupying a groove formed by the psoas and iliacus muscles.

If the student will now review the parts which he has just dissected with reference to the protrusion of the bowel in hernia, he will have no difficulty in understanding the manner in which the protrusion takes place, and the new relations the bowel acquires to the surrounding parts.

He will observe that the bowel, in escaping from the cavity of the abdomen, first passes through the femoral ring and gets into the crural canal, carrying with it the peritoneum and the subperitoneal areolar tissue. If it remained in the canal, it would be called *concealed femoral hernia.* It does not, however, generally stop here, but forces its way *through* that part of the anterior wall of the canal which corresponds to the saphenous opening in the fascia lata, and then turns upwards and outwards over the falciform process, and sometimes over Poupart's ligament, beneath the superficial fascia and the skin, thus forming a curve, with the concavity looking upwards, and the convexity downwards.

It will be seen that the bowel is now covered, proceeding from without inwards; first, by the *skin;* secondly, by the *superficial fascia;* thirdly, by the *subperitoneal areolar tissue* or the *fascia propria;* and fourthly, by the *peritoneum* which forms the *sac.* The first two layers are obtained outside the femoral canal, and the other two, one within it, and one in the cavity of the abdomen.

In reducing the bowel by taxis, it should be pushed *downwards*, *backwards*, and *upwards*, the lower extremity having

first been placed in a proper position. In cutting a stricture at the upper part of the crural canal, the incision should be made upwards, or upwards and inwards.

In continuing the dissection of the thigh, the integument must be dissected off down as far as the tubercle of the tibia, both in front and on the sides. To do this, the incision, commenced at the anterior superior spinous process of the ilium, may be extended down below the outer side of the knee, and then carried across the leg to the inner side. Having done this, the integument may be reflected from the outer to the inner side of the limb.

The superficial fascia of the thigh requires no further notice. It passes over the knee, and is continuous with that of the leg. The saphenous vein may be traced down as far as the skin has been removed. The cutaneous nerves, Fig. 208, as was mentioned in the previous dissection, are derived from the lumbar plexus, the genito-crural and the anterior crural, and also from the obturator nerve.

The *anterior branch* of the external cutaneous nerve usually perforates the fascia lata about four inches below Poupart's ligament. It supplies the integument on the inner and anterior part of the thigh.

The *middle cutaneous nerve*, a branch of the anterior crural, usually becomes subcutaneous four or five inches below Poupart's ligament. It passes down on the fore part of the thigh to the knee. It frequently divides into two branches, nearly of the same size, soon after perforating the fascia lata.

The *internal cutaneous nerve* is also a branch of the anterior crural nerve. It perforates the fascia lata on the inner part of the thigh, about three inches above the knee, and then passes down to the internal condyle of the femur, where it turns outwards over the patella, and ends in the skin on the outer side of the knee. In its course down the thigh, this nerve frequently gives off several branches, which perforate the fascia lata at different points, and become subcutaneous. One or two of these branches accompany the saphenous vein for a short distance.

The *internal saphenous nerve*, Fig. 207 (6), becomes subcutaneous at the inner side of the knee, and then continues as such down the leg, in company with the internal saphenous vein. Before becoming subcutaneous, it gives off a branch, which is lost in the skin which covers the patella. Quite a

large cutaneous branch is sometimes found on the inner side of the knee and the upper and back part of the leg, that is derived from the obturator nerve. When this occurs, it takes the place of a branch of the internal cutaneous nerve. The cutaneous nerves of the thigh anastomose with each other.

The superficial fascia may now be removed by first making an incision through it down the middle of the thigh, and over the patella, and then reflecting it outwards and inwards. A *bursa mucosa*, situated in the subcutaneous areolar tissue, between the skin and the patella, should be observed. The density of the fascia, and the absence of adipose tissue in the vicinity of the patella, should also be noticed. However much adipose substance there may be above and below the patella, there is very little, if any, ever found in front of it.

In examining the fascia lata at this stage of the dissection, it will be found to divide into two layers below the anterior superior spinous process of the ilium, to inclose the *tensor vaginæ femoris muscle*, and then to pass to the gluteus medius. It should not be exposed much posterior to the tensor muscle at present. The superficial layer may now be divided from the spinous process downwards, and somewhat backwards, to the extent of three or four inches, exposing the tensor vaginæ femoris.

The Tensor Vaginæ Femoris, Fig. 211 (4), *arises* tendinous from the anterior superior spinous process of the ilium, and, passing downwards and backwards, is *inserted*, about four inches below its origin, into the fascia lata; the two layers which form its sheath being here united. In dissecting out the tensor vaginæ femoris, some care is necessary not to expose the gluteus medius and minimus muscles. Below and behind the insertion of the tensor vaginæ femoris, the fascia lata is connected to the tendon of the gluteus maximus, and, below this, to the linea aspera and the external condyle of the femur. The action of the tensor vaginæ femoris will now be easily understood. It first renders the fascia tense, and then rotates the thigh inwards by acting on the linea aspera through the fascia.

The vastus externus Fig. 211 (7), arises for some distance from the fascia lata, near its attachment to the linea aspera, and it will be seen, in the dissection of the posterior part of the thigh, that the short head of the biceps flexor arises

from the corresponding surface on the other side. This part of the fascia is called the *external intermuscular septum.* It separates the muscles on the outer from those on the back part of the thigh. Below, the fascia passes down in front of the knee. Internally, it is inserted into the linea aspera from the trochanter minor to the internal condyle. This part forms the *internal intermuscular septum.*

As the dissection is continued, it will be found that the fascia lata sends in processes from its inner surface to form sheaths for the different muscles, and also for the femoral vessels. If, in removing this fascia, the student will first look at the drawing, Fig. 211, he will see the muscles which are to be exposed, and then, by dividing the fascia on each muscle, and in the direction of its fibres, he will have no difficulty in making a clear exposition of them. With a little care and patience, he will be able to do this, and, at the same time, preserve the principal vessels and nerves.

Fig. 211.

The SARTORIUS, Fig. 211 (5), *arises* tendinous from the anterior superior spinous process of the ilium and from the notch below, passes obliquely downwards, inwards, and somewhat backwards, to the lower third of the thigh, and then directly downwards to the inner side of the knee-joint, where it becomes tendinous, and, curving outwards round the joint, is *inserted* into the tibia just below and on the inner side of its tubercle. It covers the tendons of the gracilis and semi-tendinosus, and is connected to the deep fascia of the leg. The internal saphenous nerve will be seen

THE MUSCLES OF THE ANTERIOR FEMORAL REGION.—1. The crest of the ilium. 2. Its anterior superior spinous process. 3. The gluteus medius. 4. The tensor vaginæ femoris; its insertion into the fascia lata is shown inferiorly. 5. The sartorius. 6. The rectus. 7. The vastus externus. 8. The vastus internus. 9. The patella. 10. The iliacus internus. 11. The psoas magnus. 12. The pectineus. 13. The adductor longus. 14. Part of the adductor magnus. 15. The gracilis.

emerging between its anterior border and the tendon of the gracilis, opposite the internal condyle. It increases somewhat in breadth as it descends to the lower part of the thigh. Its fibres are the longest in the body. Its action is first to flex the leg on the thigh, and then the thigh on the pelvis, and, at the same time, draw the limb across the other.

The gracilis may be dissected next, as its dissection will involve no important vessel or nerve.

The GRACILIS, Fig. 211 (15), *arises* by a thin, flat tendon, from the body and ramus of the pubic bone by the side of the symphysis, descends on the inner side of the thigh and knee-joint, and is *inserted* into the inner side of the tubercle of the tibia. It diminishes in width from above downwards; its borders look forwards and backwards; and it becomes tendinous a short distance above the knee. Its action is to flex the leg on the thigh and move it towards the opposite limb.

The sartorius and gracilis may now be detached at their origins and turned downwards; and also the tensor vaginæ femoris. They must be preserved for the purpose of replacing them at a future time to study their relations to other parts. On raising the sartorius, the middle cutaneous nerve will be seen perforating it.

The next stage of the dissection will include the femoral artery and its branches, the femoral vein, and the branches of the anterior crural nerve under the fascia lata. To expose these satisfactorily will re-

Fig. 212.

A VIEW OF THE ANTERIOR CRURAL NERVE AND BRANCHES.—1. Place of emergence of the nerve under Poupart's ligament. 2. Division of the nerve into branches. 3. Femoral artery. 4. Femoral vein. 5. Branches of obturator nerve. 6. Nervus saphenus.

quire time and patience. They should be carefully studied before their dissection is commenced; and when begun the scissors as well as the scalpel and the hooks will be brought in requisition in the removal of the areolar tissue and the adipose substance in which they are imbedded.

The femoral artery and vein have already been exposed in the infundibuliform sheath. The anterior crural nerve should be sought in the sulcus formed by the iliacus and psoas muscles; and when found it should be raised up and made tense, so that the direction of its branches may be distinctly seen and more readily traced.

It is better to follow out the principal branches of the crural nerve before commencing the dissection of the vessels. This is readily done with the point of the scalpel, when they are rendered tense, separating them partly by cutting and partly by tearing. They consist of *cutaneous* and *muscular branches.* The *former* were described after they became subcutaneous in connection with the superficial fascia. The middle cutaneous was divided in raising the sartorius. The internal cutaneous descends to the outer side of the artery three or four inches, and then perforates the fascia lata. In this part of its course it gives off several cutaneous filaments, some small branches to the sartorius and to the sheath of the femoral vessels, and others to anastomose with the saphenous and obturator nerves. The saphenous nerve passes down on the outer side of the artery, but leaves it when the artery enters the popliteal region; it then proceeds to the inner side of the knee-joint and becomes subcutaneous. In the deep part of its course it gives off some cutaneous and muscular branches and also filaments to anastomose with other nerves.

The *muscular branches* require no particular description. They will be found supplying the muscles on the outer side and fore part of the thigh; also, the pectineus, and in part the adductor longus, on the inner side. A large branch goes to the lower part of the vastus internus, which has been called the *short saphenous nerve.*

The Femoral Artery, Fig. 206 (14), commences at a point a little to the inner side of the middle of Poupart's ligament, and extends to the junction of the middle and lower thirds of the thigh, when it passes through a tendinous canal formed by the adductor magnus and the vastus internus, to enter the popliteal space.

The femoral artery is accompanied by the FEMORAL VEIN, which is at first placed to its inner side and on the same plane, but soon gets behind, and in the last part of its course, a little to the outer side of it. The saphenous nerve lies close to the outer side of it, except at its upper part. Small nervous twigs are usually met with either accompanying the artery, crossing it, or twining around it.

The branches of the femoral artery to be examined next are the inferior external pudic and the profunda, or the deep femoral artery. Several small branches in the groin have already been dissected.

The *inferior external pudic*, Fig. 206 (16), arises near the profunda, sometimes from the profunda itself, passes inwards over the femoral vein below its junction with the saphenous, and the pectineus muscle to the ramus of the pubes, and thence to the scrotum, in the male, or to the labium externum in the female. It perforates the fascia lata near the pubic bone.

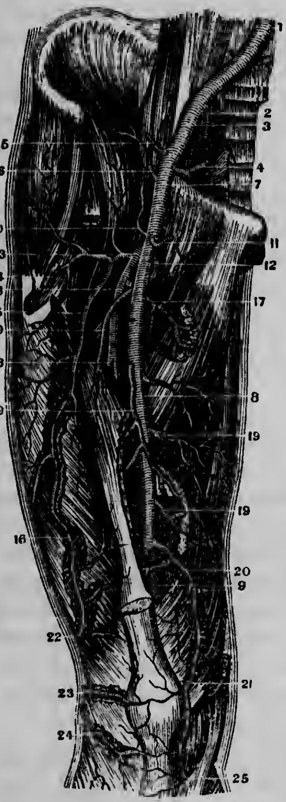
The ARTERIA PROFUNDA, Fig. 213 (13), arises from the outer and back part of the femoral, about an inch and a half below Poupart's ligament; the point of its origin, however, varies very much in different subjects. It may not be more than half an inch below Poupart's ligament, or it may be two or three inches. At first it passes backwards and somewhat outwards, and then directly downwards to the upper border of the adductor longus, beneath which it continues down to the lower third of the thigh resting on the adductor brevis and the adductor magnus. It perforates the last named muscle and its terminal branches are distributed to the back part of the thigh. In the last part of its course it is very deep seated, running behind and nearly parallel with the femoral artery. It gives off the following branches:—

The *external circumflex*, Fig. 213 (13), which frequently arises from the femoral artery, passes transversely outwards behind the rectus and in front of the psoas and iliacus muscles and divides into descending, transverse, and ascending branches. This artery and its branches behind and to the outer side of the rectus, can be traced more readily after that muscle has been dissected.

The *internal circumflex*, Fig. 213 (12), which also occasionally arises from the femoral, is usually larger than the ex-

ternal. It passes almost directly backwards between the pectineus and the capsular ligament of the hip-joint. It cannot be followed further at the present time.

Fig. 213.



Besides the circumflex the profunda gives off three or four *perforating branches*, Fig. 190 (19), Fig. 213 (18). These pass through the adductor magnus and are expended on the back of the thigh. Sometimes they arise by a common trunk.

The *veins* correspond to the arteries just described. The vein which accompanies the profunda artery lies between it and the femoral artery. In dissecting the arteries the veins may be cut away. The arteries should be preserved until the muscles have been dissected, so that their relations to the muscles may be observed.

The *quadriceps extensor cruris* may now be examined. As its name indicates it is a muscle having four heads. These are usually described as separate muscles. They are named the rectus femoris, the vasti externus and internus, and the crureus. They cover nearly the whole of the anterior and lateral surfaces of the femur.

To expose these muscles divide the fascia lata along the middle

A Front View of the Femoral Artery, as well as of the Primitive and External Iliac of the Right Side.—1. Primitive iliac artery. 2. Internal iliac artery. 3. External iliac artery. 4. Epigastric artery. 5. Internal circumflex ilii artery. 6. Arteria ad cutem abdominis. 7. Commencement of the femoral just under the crural arch. 8. Point where it passes the vastus internus muscle. 9. Point where it leaves the front of the thigh to become popliteal. 10. Muscular branch to the psoas and iliacus. 11. External pudic artery cut off. 12. Origin of the internal circumflex. 13, 13. Profunda femoris; first 13 points to origin of external circumflex. 14. Muscular branch. 15, 16. Artery to the vastus externus. 17. Artery to the pectineus and adductors. 18. First perforating artery. 19, 19, 19, 19. Muscular arteries. 20. Anastomotica. 21. Superior internal articular. 22. Branch of superior external articular. 23. Superior external articular. 24. Inferior external articular. 25. Inferior internal articular.

line of the thigh down to the patella, and dissect it off from the muscles by cutting in the direction of their fibres.

The RECTUS, Fig. 211 (6), *arises* by two short tendinous heads, one from the anterior inferior spinous process of the ilium, and the other from the superior margin of the acetabulum. From this double origin it proceeds downwards on the front part of the thigh to the patella, into which it is *inserted.* It is broader and thicker in the middle than above or below. Its tendon at first is somewhat round, but expands as it descends, and is prolonged much further on the anterior than on the posterior part of the muscle, while in the lower part the tendon extends further up behind than it does in front. The fibres pass off obliquely on both sides from the middle line, and hence it is called a penniform muscle. The action of the rectus is to assist in extending the leg on the thigh, or in flexing the thigh on the pelvis.

The rectus may now be divided in the middle and turned upwards and downwards, and the dissection of the external circumflex artery completed.

The VASTUS EXTERNUS, Fig. 211 (7), *arises* around the base of the trochanter major, from the linea aspera, from the ridge which runs from it to the trochanter, and also from the external intermuscular septum of the fascia lata. It is *inserted* into the patella and the tendon of the rectus. The direction of its fibres increase in obliquity from above downwards, the upper fibres descending almost perpendicularly, while the lower are nearly transverse. It is separated from the crureus beneath it by vessels, nerves, and areolar tissue; this space should be observed with reference to the collection of pus in it.

The VASTUS INTERNUS, Fig. 211 (8), is placed on the inner side of the thigh, and is not separated by any natural division from the crureus. It *arises* from the linea aspera and from a rough line extending from the linea aspera to the trochanter minor, and also from the internal intermuscular septum. It is *inserted* into the patella and the tendon of the rectus.

The *crureus*, Fig. 214 (15), *arises* from the anterior surface of the femur, commencing above at the anterior intertrochanteric ridge, and extending downwards between the origins of the vasti to a short distance above the condyles. It is *inserted* into

the tendon of the rectus and into the patella. When the crureus is raised a fasciculus will be found going to the upper part of the synovial membrane of the knee-joint. This is called the *subcrureus muscle.* Its action is supposed to be to draw the synovial membrane upwards, so that it may not be pinched between the articular surfaces of the joint. It should be observed that the crureus does not occupy in its origin the whole of the anterior surface of the femur.

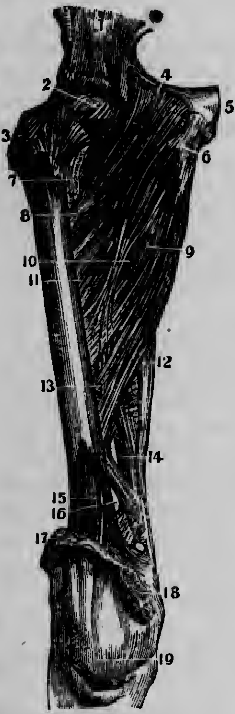
The action of the vasti and crureus muscles is to assist the rectus in extending the leg on the thigh. These four muscles, it will be seen, are *attached* to the tubercle of the tibia through the medium of the patella and the ligament of the patella.

The pectineus and the adductor muscles, including the lower portion of the psoas magnus and iliacus internus, may now be examined. The last-named muscles have already been described.

The PECTINEUS, Fig. 214 (4, 8), is situated at the upper and anterior part of the thigh. It *arises* from the pectineal line, and from a triangular surface in front of this line, passes downwards, and is *inserted* into the ridge which extends from the trochanter minor to the linea aspera.

The ADDUCTOR LONGUS, Fig. 214 (6, 9, 10), lies on the inner side of the pectineus, with which it is usually

Fig. 214.



A VIEW OF THE DEEP-SEATED MUSCLES ON THE INSIDE OF THE THIGH.—1. Os ilii. 2. Capsular ligament of the hip-joint. 3. Trochanter major. 4. Origin of the pectineus muscle. 5. Symphysis pubis. 6. Origin of the adductor longus. 7. Insertion of the iliacus internus and the psoas magnus. 8. Insertion of the pectineus. 9. Middle of the adductor longus. 10. Tendinous insertion of the adductor longus. 11. Part of the adductor brevis seen between the pectineus and adductor longus. 12. Adductor magnus. 13. Aperture for the passage of bloodvessels. 14. Adductor magnus with opening for the femoral vessels. 15. Portion of the crureus. 16. Another opening for vessels. 17, 18. Cut tendon of the quadriceps femoris. 19. Ligament of the patella.

closely connected at its upper part, but separated from it below by a triangular areolar interspace, in which the adductor brevis is seen. It *arises*, by a narrow, flat tendon, from the spine and body of the pubes, passes downwards, backwards, and outwards, and is *inserted* into the linea aspera at the middle third of the femur. Near its insertion, it is connected by tendinous fibres to the adductor magnus and vastus internus. It is perforated by branches of the arteria profunda femoris.

The pectineus and adductor longus should now be detached at their origins, and carefully turned downwards for the purpose of examining the anterior or superficial branches of the obturator nerve, which are situated immediately behind these muscles.

The *obturator nerve*, Fig. 212 (5), enters the inner and upper part of the thigh through the sub-pubic canal in the obturator foramen. As it leaves the canal, or just before it leaves, it gives off one or two twigs to the obturator externus muscle, and to the hip-joint; it then divides into its superficial and deep branches. The former pass in front of the adductor brevis, and the latter behind it. The *superficial branches* are distributed to the pectineus, adductor brevis, adductor longus, gracilis, and the vastus internus muscles. After passing beneath the pectineus and the adductor longus, a branch proceeds to join the plexus formed on the inner side of the thigh by branches derived from the internal cutaneous and saphenous nerves. Vaginal branches are also sent to the femoral artery. The *accessory obturator nerve* will be found beneath the pectineus muscle. This nerve reaches the thigh by passing over the brim of the pelvis near the pectineal eminence. It usually anastomoses with the obturator nerve, and sends a filament to the pectineus, and one to the hip-joint. The *deep division* of the obturator nerve perforates the obturator externus, to which it sends filaments. It then descends on the adductor magnus, to which it is principally distributed. One branch leaves this muscle and joins the femoral artery as it enters the popliteal space. It terminates in *articular branches* to the knee-joint, and to the upper and back part of the leg.

The adductor brevis and magnus muscles may now be dissected.

The Adductor Brevis, Fig. 214 (11), *arises* from the pubes

below its spine, and to the outer side of the origin of the gracilis. It passes downwards, outwards, and a little backwards, and is *inserted* into the upper part of the linea aspera.

The adductor brevis should now be raised and turned downwards, and the deep branch of the obturator nerve, and the branches of the obturator artery, traced.

The ADDUCTOR MAGNUS, Fig. 214 (12), is a very large muscle, forming a large portion of the fleshy mass on the inner and upper part of the thigh. It cannot be fully examined until the back part of the thigh is dissccted. It *arises* from the ramus and anterior part of the tuberosity of the ischium, and from the descending ramus of the pubes. Its fibres pass outwards and downwards, and are *inserted* into the linea aspera through its entire length, and into a tubercle on the inner aspect of the internal condyle of the femur. Its upper fibres have nearly a transverse direction, while those below increase in obliquity from above downwards. The portion of the muscle which is inserted into the linea aspera, is separated from that portion inserted into the condyle by the femoral vessels and their sheath; its tendon is here connected to that of the vastus internus, so as to form a tendinous arch over these vessels as they enter the popliteal region. By observing the direction of the fibres of the inner portion of this muscle, it will be seen that, when it contracts, it cannot compress the femoral vessels. The perforating branches of the arteria profunda, with their accompanying veins, pass through openings formed in the tendon of this muscle.

The action of the adductor muscles, including the pectineus, is to approximate the lower extremities; they will also assist in rotating the thigh outwards. The pectineus and adductor longus may assist in flexing the thigh on the pelvis, or the pelvis on the thigh.

The *obturator externus* is partly brought into view when the pectineus and adductor brevis are turned down. It will be described in the dissection of the posterior part of the pelvis and thigh.

The psoas magnus and iliacus internus muscles should now be divided and reflected downwards, so as to expose in front the capsular ligament of the hip-joint, Fig. 214 (2).

Sect. II.—The Gluteal Region.

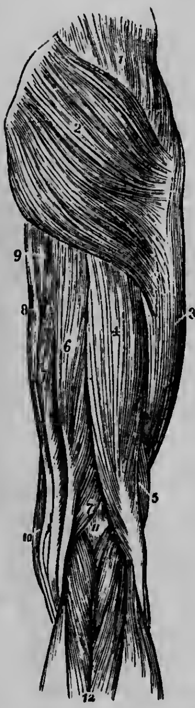
This region includes those parts which are found on the side and posterior part of the pelvis. To dissect it the subject must be placed on its face with the pelvis raised a foot or more by means of blocks. It is a matter of little consequence in what direction the incisions are made for the purpose of removing the integument unless it is intended to remove the fascia at the same time. In this case the incisions should be made so that the gluteus maximus muscle may be exposed by cutting in the direction of its fibres.

To examine the cutaneous nerves the integument must be dissected off and the nerves traced in the superficial fascia and fat, which usually exists in great abundance in this region. The *nerves* are derived from the last *dorsal*, the *lumbar*, and the *sacral*. These enter the gluteal region at different points. The *gluteal branch* of the external cutaneous nerve enters it from the anterior part of the thigh just below the anterior superior spinous process of the ilium. *Two branches*, one from the last dorsal and another from the superior musculo-cutaneous, pass over the crest of the ilium, the former anterior to the middle of the crest, the latter more posteriorly. The *posterior divisions* of the last two lumbar are distributed principally to the skin in the gluteal region. There are *two* or *three* derived from the posterior divisions of the sacral nerves; also *filaments* from the lesser sciatic nerve.

Beneath the superficial fascia will be found the *gluteal aponeurosis*. This is attached above and behind to the crest of the ilium, to the sacrum, and to the coccyx; in front and below it is continuous with the fascia lata. It is quite thin where it covers the gluteus maximus, but thick and dense over that portion of the gluteus medius which is not covered by the preceding muscle; the gluteus medius arises partly from its under surface; a layer of it passes beneath the gluteus maximus. It is separated from the great trochanter and the tuberosity of the ischium by synovial capsules.

The Gluteus Maximus, Fig. 215 (2), is the first muscle to be dissected in this region. To expose it an incision should be made through the skin and fascia, if the skin has not been

Fig. 215.



THE MUSCLES OF THE GLUTEAL AND POSTERIOR FEMORAL REGIONS.—1. The gluteus medius. 2. The gluteus maximus. 3. The vastus externus, covered in by fascia lata. 4. The long head of the biceps. 5. Its short head. 6. The semi-tendinosus. 7, 7. The semi-membranosus. 8. The gracilis. 9. A part of the inner border of the adductor magnus. 10. The edge of the sartorius. 11. The popliteal space. 12. The gastrocnemius muscle; its two heads. The tendon of the biceps forms the outer hamstring; and the sartorius, with the tendons of the gracilis, semi-tendinosus, and semi-membranosus, the inner hamstring.

previously removed, from near the middle of the sacrum to a short distance below the trochanter major. This incision should be made down to the muscle, so that its fibres or fasciculi, which are very coarse, may be distinctly seen. If the fibres are now made tense the student will have no difficulty in exposing the muscle by dissecting one flap upwards and the other downwards, being careful to observe the direction of the fibres. This muscle *arises* from the dorsum of the ilium above and behind the superior semicircular ridge, from the tubercles on the posterior surface of the sacrum, from the coccyx and the great sacro-sciatic ligament. Some of its fibres also arise from the aponeurosis of the gluteus medius. It passes obliquely downwards and outwards over the trochanter major, from which its tendon is separated by quite a large *bursa mucosa*. The lower part of the muscle is *inserted* into the rough line which extends from the trochanter major to the linea aspera. The upper part is connected to the fascia lata of the thigh. A *bursa* separates its tendon from the vastus externus, and not unfrequently *another* one separates it from the tuberosity of the ischium. Its lower border is free, and forms the lower boundary of the nates or buttock, while the upper border is blended with the aponeurosis of the gluteus medius, and can be distinguished from this muscle only by observing the different direction of the fibres of the two muscles. When the gluteus

maximus is fairly exposed and properly studied it should be carefully raised by detaching it from its origin and reflecting it downwards. As it is raised, the gluteal artery and nerve, and the gluteal branches of the sciatic artery and lesser sciatic nerve will be found entering the muscle upon its under surface. The gluteus medius should now be dissected and studied.

The GLUTEUS MEDIUS, Fig. 216 (6), *arises* from the dorsum of the ilium between the middle and superior semicircular ridges and the crest of the ilium. That portion of it not covered by the gluteus maximus has a very thick dense aponeurosis, from the under surface of which many of its fibres arise. Its fibres converge to form a short thick tendon, which is *inserted* into the outer part of the trochanter major. It will be observed that the direction of the fibres of this muscle, viewed in relation to the hip-joint, is quite different from that of the fibres of the preceding muscle; that

Fig. 216.

A VIEW OF THE DEEP-SEATED MUSCLES ON THE POSTERIOR PART OF THE HIP-JOINT.—1. Fifth lumbar vertebra. 2. Ilio-lumbar ligament. 3. Crest of the ilium. 4. Anterior superior spinous process of ilium. 5. Part of the fascia lata. 6. Gluteus medius. 7. Its lower and anterior portion. 8. Pyriformis. 9. Gemelli. 10. Trochanter major. 11. Insertion of the gluteus medius. 12. Quadratus femoris. 13. Part of the adductor magnus. 14. Insertion of the gluteus maximus. 15. Vastus externus. 16. Long head of the biceps. 17. Semi-membranosus. 18. Semi-tendinosus. 19. Tuber ischii. 20. Obturator internus. 21. Point of the coccyx. 22. Posterior coccygeal ligament. 23, 24. Great sacro-sciatic ligament. 25. Posterior superior spinous process of ilium. 26. Posterior sacro-iliac ligament.

while those of the latter are directed generally from behind forwards and downwards, those of the former are directed not only from behind downwards and forwards, but from above downwards, and also from before downwards and backwards. Its lower border is placed in juxtaposition with the pyriformis muscle, from which some care will be requisite to separate it. Its under surface is penetrated by branches of the gluteal artery and nerves. This muscle should now be detached from its origin and turned downwards, when the gluteus minimus will be brought into view.

The GLUTEUS MINIMUS, Fig. 219 (8), *arises* from the dorsum of the ilium between the middle and inferior semicircular ridges. Its fibres converge and unite in a short tendon, which is *inserted* into the anterior border of the trochanter major. The direction of its fibres is the same as that of the fibres of the gluteus medius. The capsular ligament of the hip-joint is placed immediately beneath this muscle.

The action of the glutei muscles varies according as the pelvis or the femur is the fixed point, also according as the three muscles act together or separately. When standing on one leg these muscles hold the pelvis *in sitû*, and thus keep the body in the erect position; or they may incline it to their own side, or rotate it on the head of the femur. They are capable of rotating the limb inwards or outwards, also of abducting or extending it. They are concerned in walking. The gluteus maximus also renders tense the fascia lata.

The following vessels and nerves should now be examined:—

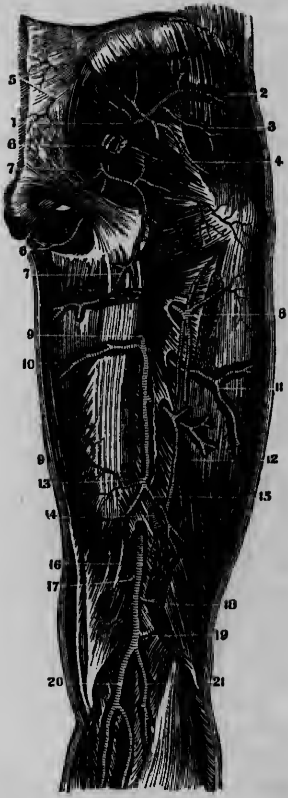
The *gluteal artery*, Fig. 217 (1), is a branch of the internal iliac. It escapes from the pelvis through the upper part of the great sacro-sciatic foramen, and appears in the gluteal region between the pyriformis and gluteus minimus muscles. It divides into a superficial and deep branches. The *superficial branch* passes forwards, and divides into several branches between the glutei maximus and medius. These are distributed principally to the upper part of the gluteus maximus and the integument of this region. The *deep branches* ramify between the glutei medius and minimus, which muscles they supply. One or more of these pass upwards and forwards to the anterior superior spinous process of the ilium, where it anastomoses with the external circumflex artery, a branch of the arteria profunda, and also with the external

circumflex ilii, a branch of the femoral artery. Other branches are directed towards and above the trochanter major. The *gluteal nerves* are divided into the superior and inferior.

The *superior gluteal nerve*, Fig. 218 (2), is a branch of the lumbo-sacral cord. It accompanies the gluteal artery through the great sacro-sciatic foramen. It divides into two principal branches. One of these accompanies the superior deep branch of the gluteal artery; the other is directed downwards and forwards above the trochanter major, and terminates in the tensor vaginæ femoris muscle. These nerves supply the glutei medius and minimus.

The *inferior gluteal nerve* comes from the small or lesser sciatic nerve. It consists of muscular and cutaneous branches. The former are distributed to the gluteus maximus; they penetrate its under surface. The cutaneous branches descend below the lower border of the gluteus maximus, where some filaments ascend to

Fig. 217.



A View of the Arteries on the Back of the Buttock and Thigh, as well as on the Back of the Ham.—1. Gluteal artery as it escapos from tho pelvis. 2, 3, 4. Branches which it furnishes to the gluteus medius aud gluteus minimus muscles. 5. Small cutaneous arteries given off by the posterior branches of the sacral arteries. 6, 6. Internal pudic, from its exit from the pelvis to the root of the penis. 7, 7. Sciatic artery as it escapes from the pelvis to its distribution to the biceps and semi-tendinosus muscles, as well as its branches to the gemelli, pyriformis, and quadratus femoris muscles. 8. Termination and distribution of internal circumflex. 9. Profunda femoris seen in the thickness of the adductors. 10. A branch to adductor longus and brevis. 11. First perforating artery, going to vastus externus. 12. Second perforating artery. 13. Third perforating artery. 14. Termination of profunda femoris. 15. A branch to the short head of the biceps. 16. Popliteal artery. 17, 18, 19. Its articular branches. 20, 21. Gastrocnemial arteries.

supply the integument covering this muscle, while other filaments are distributed to the skin below it.

The *sciatic artery*, Fig. 217 (7, 7), is a branch of the internal iliac. It leaves the pelvis through the lower part of the great sacro-sciatic notch, below the pyriformis. In the first part of its course, it gives off branches to the gluteus maximus, some of which pass through the muscle, and supply the integument over it. One or more branches, named coccygeal, usually perforate the great sacro-sciatic ligament, and ramify on the dorsum of the sacrum, and in the coccygeal region. Another branch, called the *comes nervi ischiadici*, goes to the great sciatic nerve, and accompanies it for some distance down the thigh. The sciatic artery, after giving off these branches, descends in a line midway between the trochanter major and tuberosity of the ischium on the gemelli, the obturator internus, and the quadratus femoris muscles, which are supplied with branches derived from it. It gives off branches to anastomose with the internal circumflex and perforating branches of the arteria profunda.

Fig. 218.

A View of the Branches of the Sacral Plexus to the Hip and Back of the Thigh.—1, 1. Posterior sacral nerves. 2. Superior gluteal nerve. 3. The internal pudic nerve (nervus pudendalis longus superior). 4. The lesser sciatic nerve, giving off the perineal cutaneous (pudendalis longus inferior); and 5. The ramus femoralis cutaneus posterior. 6. The great sciatic nerve.

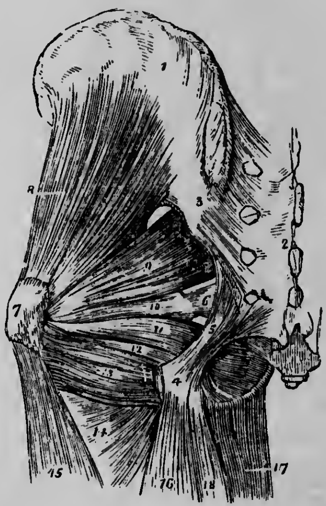
The *internal pudic artery*, Fig. 217 (6, 6), another branch of the internal iliac, escapes from the pelvis in company with the sciatic, but leaves it almost immediately to wind around the spine of the ischium, and enter the perineum through the small sacro-sciatic foramen.

The Great Sciatic or Ischiatic Nerve, Fig. 218 (6), is a continuation of the sacral plexus. It is the largest nerve in

the body. It leaves the pelvis in company with the sciatic artery and the lesser sciatic nerve, and descends between the trochanter major and tuberosity of the ischium to the posterior part of the thigh. Sometimes the whole, or a part of it, perforates the pyriformis muscle. It usually gives off one or more small articular branches to the hip-joint. As it passes over the quadratus femoris, or a little below this muscle, branches are sent off from it to the muscles on the back of the thigh, including the adductor magnus.

The *lesser sciatic nerve*, Fig. 218 (4), is derived from the sacral plexus. As it leaves the pelvis it lies at the inner side of the great sciatic nerve, but gets behind it as it descends to the back part of the thigh. Besides the inferior gluteal nerve, it gives off at the lower part of the gluteus maximus the *inferior long pudendal nerve.* It then continues down the limb to the popliteal region and the upper part of the leg. The inferior pudendal nerve passes forwards below the tuberosity of the ischium to reach the anterior part of the scrotum.

Fig. 219.



THE DEEP MUSCLES OF THE GLUTEAL REGION.—1. The external surface of the ilium. 2. The posterior surface of the sacrum. 3. The posterior sacro-iliac ligaments. 4. The tuberosity of the ischium. 5. The great or posterior sacro-sciatic ligament. 6. The small or anterior sacro-sciatic ligament. 7. The trochanter major. 8. The gluteus minimus. 9. The pyriformis. 10. The gemellus superior. 11. The obturator internus, passing out of the lesser sacro-sciatic foramen. 12. The gemellus inferior. 13. The quadratus femoris. 14. The upper part of the adductor magnus. 15. The vastus externus. 16. The biceps. 17. The gracilis. 18. The semi-tendinosus.

The *internal pudic* and the *inferior hemorrhoidal nerves*, Fig. 218 (3), will be seen at this stage of the dissection, passing around the spine of the ischium and through the small sacro-sciatic foramen to enter, in company with the internal pudic artery, the perineum.

The following group of small muscles may now be examined as they appear in the dissection of this region.

They will be found to occupy nearly the same plane with each other and with the gluteus minimus, except the obturator externus.

Before commencing the dissection of them, the student should be particular to see that the limb is rotated inwards and fastened in this position so that the muscles shall be kept tense.

The PYRIFORMIS, Fig. 219 (9), lies along the lower border of the gluteus medius, and not unfrequently some care is required to find the line which separates them. It *arises* within the pelvis from several of the spaces between the anterior sacral foramina and from the contiguous portion of the ilium, also from the great sacro-sciatic ligament. Its fibres converge as they pass outwards and somewhat backwards to be *inserted* by a round tendon into the fossa on the upper and back part of the great trochanter. This muscle is sometimes perforated by the great sciatic nerve, or by a portion of it.

The GEMELLUS SUPERIOR, Fig. 219 (10), is a small muscle placed immediately below the pyriformis. It *arises* from the spine of the ischium, and, passing horizontally inwards, is *inserted* into the trochanter major close to the pyriformis. It is sometimes wanting.

The GEMELLUS INFERIOR, Fig. 219 (2), *arises* from the tuberosity of the ischium near the attachment of the great sacro-sciatic ligament. It is *inserted* also into the trochanter major. It is usually larger than the gemellus superior.

The OBTURATOR INTERNUS, Fig. 219 (11), will be found placed between the two gemelli occupying the small sacro-sciatic foramen. The principal part of this muscle is situated within the pelvis, and will require for its complete dissection, as well as that of the pyriformis, a section of the pelvic parietes to be made.

It *arises* from the internal surface of the innominatum around the obturator foramen, from the obturator ligament and from the outer surface of the aponeurosis which covers this muscle. Its fibres converge, pass downwards and outwards through the small sacro-sciatic foramen and terminate in a tendon, which is *inserted* into the trochanteric or digital fossa in common with the gemelli. The gemelli, especially the inferior, and the obturator internus are frequently so

blended together for some distance from their insertion as to seem to form but one muscle. With a little care, however, the student will generally be able to separate them with the handle of the scalpel near the small sacro-sciatic foramen.

In passing through this foramen the tendon of the obturator is reflected over a trochlear surface, which, as well as the tendon itself, is covered by synovial membrane and kept constantly lubricated with synovial fluid.

The QUADRATUS FEMORIS, Fig. 219 (13), situated just below the inferior gemellus, *arises* from the posterior border of the tuberosity of the ischium, and passing horizontally outwards, is inserted into the linea quadrati, a rough line on the great trochanter. It is a square-shaped muscle, having its fibres nearly parallel to each other. It is separated from the upper border of the adductor magnus by the *internal circumflex artery*, which should now be examined in the terminal part of its course. This artery, by its anastomosis with the sciatic, establishes a connection between the profunda femoris and the internal iliac artery.

The OBTURATOR EXTERNUS is exposed posteriorly by raising the quadratus femoris. It *arises* from the external surface of the obturator ligament, and from the bone around the obturator foramen. Its fibres converge and terminate in a tendon which passes horizontally outwards to be *inserted* into the lower part of the digital fossa, just below the insertion of the gemelli and the obturator internus.

The action of the last six muscles is very similar. They rotate the limb when it is extended, outwards, but abduct it in the sitting posture. When the limb is fixed, as in standing on one foot, they act on the pelvis.

In raising these muscles, several small nerves will be observed penetrating them.

The *nerve for the obturator internus* arises from the sacral plexus, winds around the spine of the ischium, and passes through the small sacro-sciatic foramen to reach the muscle.

The *nerve for the quadratus femoris* arises from the sacral plexus, passes downwards underneath the gemelli and obturator internus, giving off in its course filaments to the hip-joint. Before terminating in the quadratus femoris, it sends

a small branch to the gemellus inferior. The gemellus superior receives a nerve directly from the sacral plexus.

The obturator externus is supplied with branches from the obturator nerve, which is derived from the third and fourth lumbar nerves.

Having completed the dissection of the parts in the gluteal region, the student should now replace the muscles and study their relations to the hip-joint and to the vessels and nerves. The prominent points which can be seen or felt in this region in the living subject should be observed with reference to luxation of the head of the femur and the ligation of the arteries. The exact position of the trochanter major and the tuberosity of the ischium and their relations to the sacrum and ilium, should be carefully noted. It will have been seen that the principal arteries are the gluteal, the sciatic and the internal pudic. The position of each one of these vessels may readily be ascertained by observing its relations to the posterior inferior spinous process of the ilium, the tuberosity of the ischium, and the trochanter.

As the dissection of the ligaments of the vertebral column should be made in connection with those of the pelvis, and as this cannot well be done until the external parts of the pelvis have been dissected, the dissection of the hip-joint is included with that of the others.

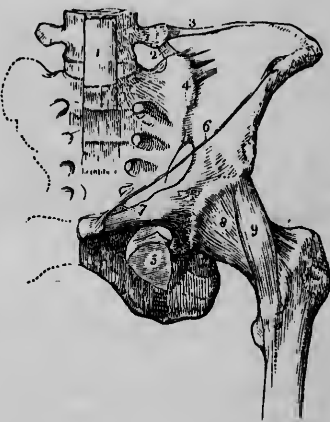
Dissection of the Hip-Joint.

The *hip-joint* is formed by the acetabulum of the os innominatum and the head of the femur. It is a ball and socket joint. At the lower part of the acetabulum is a notch occupied by the ligamentum teres and by the vessels that enter the joint; just above this notch, and in the bottom of the cavity, there is a depression occupied by adipose substance and loose synovial membrane; the rest of the acetabulum is covered by cartilage. The head of the femur forms the segment of about four-fifths of a globe. It is covered by cartilage, except a small spot just below its centre, which gives attachment to the ligamentum teres. The ligaments of this joint consist of the *capsular*, the *cotyloid*, the *round*, the *transverse*, and the *ilio-femoral*. The last two scarcely deserve to be

considered separate ligaments; the transverse properly belongs to the cotyloid, and the ilio-femoral to the capsular.

The CAPSULAR OR ORBICULAR LIGAMENT, Fig. 220 (8), like that of the shoulder-joint, completely surrounds the articulation; its fibres are not, however, like those of that ligament, intermixed with the tendons of surrounding muscles. Above and in front it is thicker and stronger than it is behind and below. Externally it is composed of longitudinal fibres which are parallel to each other, and internally of fibres that run in different directions, and interlace with each other; by this arrangement of its fibres the strength of the ligament is very much increased. Its superior attachment embraces the circumference of the acetabulum, from the margin of which, excepting the portion formed by the transverse ligament, its fibres are prolonged for some distance on the bone; its inferior attachment surrounds the neck of the femur, but not so as to include the whole of it within the joint; the principal part excluded is situated between the trochanters and above the posterior intertrochanteric ridge. This should be noticed with reference to fractures, as it allows of a fracture of the neck occurring partly within and partly without the capsular ligament; in which case, by proper treatment, osseous union may be obtained. The length of the inner and lower part of the ligament is greater than the distance between the corresponding points of attachment; hence

Fig. 220.



THE LIGAMENTS OF THE PELVIS AND HIP-JOINT.—1. The lower part of the anterior common ligament of the vertebræ, extending downwards over the front of the sacrum. 2. The sacro-vertebral ligament. 3. The ilio-vertebral ligament. 4. The anterior sacro-iliac ligament. 5. The obturator ligament. 6. Poupart's ligament. 7. Gimbernat's ligament. 8. The capsular ligament of the hip-joint. 9. The ilio-femoral or accessory ligament.

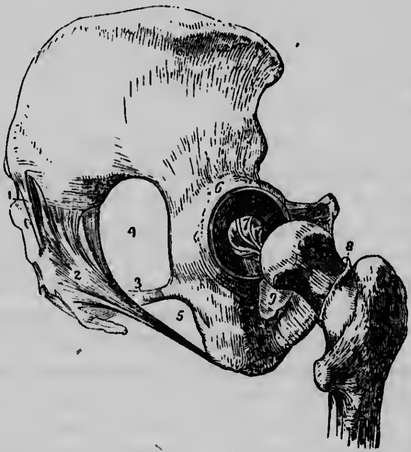
there is generally a looseness in this part of the ligament which admits of a proportionate degree of abduction of the limb. When the capsular ligament is divided, there will be observed fibres, intermixed with areolar tissue, extending from the root of the cervix to the margin of the articular surface of the head of the bone; they seem to be a continuation of the fibres of the capsular ligament reflected over the cervix, for which they form, with the areolar tissue, quite a thick sheath or covering, especially on the upper and anterior part of it. In a fracture of the neck within the capsule this fibro-areolar tissue might, no doubt, contribute largely to the formation of an osseous union. It would not only furnish a nidus in which callus might be formed, but it would be a medium for the transmission of vessels to the head of the bone; in the latter case it would co-operate with the ligamentum teres.

The *ilio-femoral* or *accessory ligament*, Fig. 220 (9), consists of a fasciculus of fibres, which arises from the anterior inferior spinous process of the ilium, passes obliquely downwards and inwards, and, spreading out, is inserted into the anterior intertrochanteric ridge. It strengthens that portion of the capsular ligament to which it corresponds. On the inner side of this fasciculus an opening is sometimes noticed which forms a communication between the bursa that is placed beneath the psoas and iliacus internus muscles and the cavity of the joint.

The Cotyloid Ligament, Fig. 221 (6), surrounds the margin of the acetabulum or cotyloid cavity. It is of a triangular form, presenting three sides; one of these, the base, is adherent to the bone; the other two are covered by synovial membrane, and correspond, the one with the head of the femur, and the other with the capsular ligament. It is not a proper ligament, but a fibro-cartilage, the cartilage increasing in quantity from the apex or free edge to the base, where there is but little fibrous tissue. It is separated by a groove from the articular cartilage which lines the acetabulum. The fibrous portion of it is continued across the notch at the lower part of the cavity; this part of the cotyloid ligament, together with other fibres that arise from the sides of the notch, constitute the Transverse Ligament. By means of this arrangement, the notch is converted into a foramen for

the transmission of vessels to the interior of the joint. What is called the transverse ligament is essentially a part of the cotyloid ligament; the addition of a few fibres which interlace with each other, and the fact of its subtending the notch does not entitle it to be considered a distinct ligament. The cotyloid ligament increases the depth of the acetabulum, and diminishes the diameter of its orifice by the edge being inclined inwards towards the centre; this constriction is seen

Fig. 221.



LIGAMENTS OF THE PELVIS AND HIP-JOINT.—THE VIEW IS TAKEN FROM THE SIDE.—1. The oblique sacro-iliac ligament. The other fasciculi of the posterior sacro-iliac ligaments are not seen in this view of the pelvis. 2. The great sacro-sciatic ligament. 3. The small sacro-sciatic ligament. 4. The great sacro-sciatic foramen. 5. The small sacro-sciatic foramen. 6. The cotyloid ligament of the acetabulum. 7. The ligamentum teres. 8. The cut edge of the capsular ligament, showing its extent posteriorly, as compared with its anterior attachment. 9. The obturator membrane only partly seen.

by the retention of the head of the femur in the cavity after the capsular ligament has been completely severed.

The INTERARTICULAR LIGAMENT, or LIGAMENTUM TERES, Fig. 221 (7), extends from the depression situated just below the centre of the head of the femur to the cotyloid notch, to the edges of which it is attached by two distinct fasciculi. It is not round, but of a triangular form, its narrow end being attached to the femur. It is from an inch to an inch

and a quarter in length; the head of the femur may be luxated downwards without this ligament being ruptured, but not upwards. It is loosely covered by synovial membrane. The ligament varies very much in size in different subjects. Sometimes it is entirely absent. Its principal use seems to be to conduct bloodvessels to and from the head of the femur, to the proper nutrition of which its presence is sometimes of the greatest importance. The depression or fossa, extending upwards from the notch in the bottom of the acetabulum, is occupied by a mass of fat, sometimes denominated a *synovial gland.* It allows vessels and nerves to enter the joint, and protects them against pressure from the head of the femur. Although called a gland, it has none of the characteristics of a gland.

The Synovial Membrane of the hip-joint lines the whole of the internal surface of the articular cavity, and surrounds the interarticular ligament. It is sometimes prolonged, as was before mentioned, into a bursa placed between the capsular ligament and the psoas and iliacus internus muscles. It not unfrequently presents folds on the neck of the femur, which may take the place in part of the round ligament in transmitting bloodvessels to the head of the femur.

The student should attentively observe all the prominent points connected with, and in the vicinity of the hip-joint; such as the crest of the ilium, the trochanter major, the pubes, and the sacrum and coccyx. The relation of the trochanter to the other points when the limb is placed in different positions, as flexed, extended, abducted, and rotated both inwards and outwards, should be noted. It is in the dissecting room, with the subject before him, that the student should prepare himself to diagnose in diseases, fractures, and luxations involving the hip-joint. It is here that he can measure for himself the distances between the different prominent points, and note the elevations and depressions as they are found in their normal condition, and then calculate the various changes which may occur from disease or injuries. He should be able, before he leaves the hip-joint, to place his finger on any point either in front of it or behind it, on the outer side or inner side of it, and specify each muscle, or any vessel or nerve that may lie between that point and the cavity of the joint. The articulation is completely surrounded by muscles. Thus in front are found the iliacus internus, psoas

magnus, and rectus femoris; on the inner side, the pectineus, obturator externus, gracilis, and the adductors; above or on the outer side, the glutei and tensor vaginæ femoris muscles; behind, the pyriformis, gemelli, obturator externus, and the quadratus femoris.

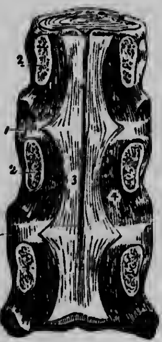
Dissection of the Articulations of the Vertebræ.

The vertebræ are connected above to the occipital bone, laterally to the ribs, and below to the pelvis. The costo-vertebral articulations are described in connection with the dissection of the thorax; the articulation of the vertebræ with the pelvis is described with the pelvic articulations. It is proposed now to examine the articulations of the vertebræ with each other, and with the cranium. The proper mode of making the dissections will be clearly indicated by the accompanying drawings. The ligaments which the vertebræ have in common should be examined first. They are the following:—

The Anterior Common Vertebral Ligament, Fig. 220 (1), is placed in front and on the sides of the bodies of the vertebræ, extending from the axis to the sacrum. It presents a pearly white appearance, is thicker in the dorsal than in the cervical or lumbar regions, and divided into a central and two lateral bands, the latter being separated from the former by a series of foramina on each side, for the transmission of vessels, especially veins. It adheres very closely to the inter-vertebral substance and margins of the bodies of the vertebræ, while it is very loosely connected to the transverse grooves on the bodies. It is composed of fibres which vary in length, diminishing from the superficial to the deep-seated; the latter extend merely from one vertebra to another, while the former pass over four or five vertebræ. It is thicker where it corresponds to the grooves on the bodies of the vertebræ than it is elsewhere. The tendons of several muscles are blended more or less with it in different sections of the vertebral column.

The Posterior Common Vertebral Ligament, Fig. 222 (3), is placed in the anterior part of the spinal canal,

Fig. 222.



A POSTERIOR VIEW OF THE BODIES OF THREE DORSAL VERTEBRÆ, CONNECTED BY (1, 1), THEIR INTERVERTEBRAL SUBSTANCE.—The laminæ (2, 2) have been sawn through near the bodies of the vertebræ, and the arches and processes removed, in order to show (3) the posterior common ligament. A part of one of the openings in the posterior surface of the vertebræ, for the transmission of the vena basis vertebræ, is seen at 4, by the side of the narrow and unattached portion of the ligament.

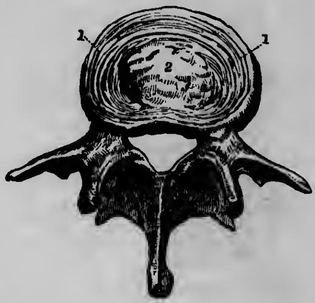
extending from the occiput to the sacrum. It is narrower opposite the body of each vertebræ than it is opposite to the intervertebral substance. It is thicker and more compact than the anterior ligament; its connection, however, with the bodies of the vertebræ and the intervening fibro-cartilage is nearly the same as that of the anterior. A plexus of veins with areolar tissue separates it from the body of each vertebra. It diminishes in width from above downwards. The length of its fibres vary in the same manner as they do in the preceding ligament. The dura mater adheres loosely to its posterior surface, being connected to it by areolar tissue.

The INTERVERTEBRAL SUBSTANCE or LIGAMENTS, Fig. 223, Fig. 224, are placed between the bodies of all the vertebræ except the first two. Each one consists of fibro-cartilage which has the form of the space that it occupies. As the bodies of the vertebræ vary in shape so does the intervertebral substance. It is usually thicker in the centre than at the circumference. It adheres so closely to the bone that the latter will break before the former will separate from it. It also possesses great strength in itself. Each one consists of lamellæ which are more numerous in front and on the sides, in the cervical and lumbar regions, than behind; the reverse is true in the dorsal region; they are thicker before than behind in the two regions first-named, while the opposite is true in the dorsal region. The anterior convexities of the column in the cervical and dorsal regions are said to be due principally to the thickness of the intervertebral substance, while the concavity in the dorsal region is attributed to the vertebræ. The heads of the ribs articulate, Fig. 144 (4), with the inter-

vertebral substance, which also assists in forming the intervertebral foramina.

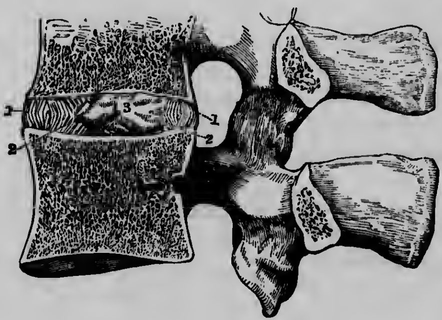
If a section of the intervertebral substance be made, it will be found to consist, Fig. 224 (3), principally of a soft pulpy substance in the centre, and of thin layers or laminæ of fibro-cartilage externally. The general arrangement of the laminæ are concentric, one being placed within another; some of them interlace with each other. They are connected together by fibres, which extend from one lamina to another. In proceeding from the circumference towards the centre, the number and compactness of the laminæ diminish, the pulpy matter and areolar tissue taking the place of them. There are fewer of them behind than in front and on the sides. The fibres which compose the laminæ are firmly attached above

Fig. 223.



A Lumbar Vertebra, with a Horizontal Section of Intervertebral Substance (1, 1), above it.—At the circumference (1, 1), the concentric arrangement of the layers of the latter is shown, and in the middle (2) the pulpy substance is indicated.

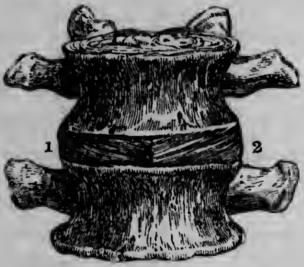
Fig. 224.



A Vertical Section of two Vertebræ, and the Substance interposed between their bodies.—The direction of the fibres of the intervertebral substance is displayed. 1, 1. Fibres curved outwards. 2, 2. Those curved inwards. 3. Pulpy substance in the middle.

and below to the vertebræ, but not at opposite points, as they have, especially those of the outer laminæ, an oblique direction, Fig. 225 (1, 2); they extend from the right to the left or from the left to the right, according as they are on the right side or left side of the median line, and according to the lamina that is examined, as in every alternate one their direction is reversed, so that the fibres of any two contiguous laminæ decussate with each other. They are also curved, Fig. 224 (1, 2), those situated externally, outwards, and those internally inwards. When the spine is lengthened and the vertebræ separated further from each other, both the obliquity and the curvature of the fibres are diminished. The same thing takes place on the side of the convexity when the spine is bent, and also on one side or the other when the spine is twisted.

Fig. 225.



TWO LUMBAR VERTEBRÆ WITH THE INTERVERTEBRAL SUBSTANCE ARE SEEN FROM BEFORE.—By removing a portion of one layer (1) of the latter, another layer (2), is partly exposed, and the oblique direction of their fibres is made manifest.

The central pulpy matter is constantly compressed, as is shown when a vertical section of two vertebræ including the intervertebral substance is made, it immediately forming a projection beyond the surrounding cut surface. The same fact is shown by pushing an awl in between two vertebræ, when it will be forced partly back again. The expansion will be greater when the preparation has been for some time macerated or soaked in water. The property of elasticity which it possesses in so large a degree is an exceedingly important element in the construction of the vertebral column.

The intervertebral substance is more abundant between the cervical and lumbar vertebræ than between the dorsal, hence these portions of the column possess a greater degree of mobility than the dorsal. In the aggregate, this substance forms about one-fourth part of the length of the spine between the axis and the sacrum.

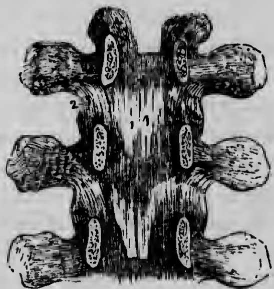
In old age the intervertebral substance possesses less elasticity, being dryer and less in bulk. The reverse is true in

the young. The uses of this substance in the spinal column will be readily understood when its structure has been properly examined. While it assists in forming the parietes of the spinal canal, the intervertebral foramina, and the costo-vertebral articulations, and while it holds the bodies of the vertebræ securely in their proper place and diminishes the force of shocks transmitted to the brain, it allows a sufficient degree of mobility to every part of the column in which it is found, and, at the same time, prevents any undue motion taking place in it.

The connection of the vertebræ by their oblique processes is very different from that which has been observed between the bodies. The oblique processes have articular facets, which are covered by a thin layer of cartilage and by synovial membrane, and articulate with those of the adjacent vertebræ. They are connected by imperfect *capsular ligaments*, which are rather longer in the neck than in the dorsal and lumbar regions.

The LIGAMENTA SUB-FLAVA, Fig. 226 (1), are composed of yellow elastic fibres, arranged in dense, compact laminæ, which occupy the spaces between the arches or laminæ of the vertebræ. The fibres are longer than the spaces between the arches, for they extend a short distance on the anterior surface, of the laminæ. They form the parietes of the spinal canal between the arches as far forwards as the roots of the transverse processes. They are thicker posteriorly than laterally, and more distinct in the lower than in the upper part of the column. They are not found in the space between the occiput and the atlas, or between the atlas and the axis. They are strong and elastic; they assist the muscles in keeping the column in an erect position and in restoring it to this position when it has been flexed.

Fig. 226.



AN INTERNAL VIEW OF THE ARCHES OF THREE VERTEBRÆ.—To obtain this view the laminæ have been divided through their pedicles. 1. One of the ligamenta subflava. 2. The capsular ligament of one side.

The SUPRA-SPINOUS LIGAMENT, Fig. 145 (1, 1), connects

the ends of the spinous processes of the vertebræ, including the occipital bone above, and the sacrum below. Between the occiput and the seventh cervical vertebra it forms what is called the *ligamentum nuchæ.* This is connected by slips to the spinous processes of all the cervical vertebræ except the first. It varies much in size. Situated in the median line, it is connected with the tendons of several muscles in this region, and can be distinguished from them only by the direction of its fibres. The same is true of the supra-spinous ligament below this, which is much larger and stronger in the lumbar region than in the dorsal.

The INTER-SPINOUS LIGAMENTS extend between the spinous processes of the dorsal and lumbar vertebræ. They are thin and membranous in the dorsal region, but quite thick and strong in the lumbar region. They are intimately connected with the tendons of the extensor muscles of the back.

The INTER-TRANSVERSE LIGAMENTS are found only in the lower part of the dorsal region and in the lumbar region. Their use seems to be as much to give attachment to the muscles as to connect the bones. These, as well as the oblique, the supra-spinous, and the inter-spinous, are inelastic.

The occipital bone is connected to the atlas by an anterior and a posterior ligament, and two on each side.

The ANTERIOR OCCIPITO-ATLANTAL LIGAMENT, Fig. 227 (1,2), may be said to consist of two, a round or superficial, and a broad or deep-seated one. Both of them extend from the anterior border of the occipital foramen to the anterior arch of the atlas. The *superficial* consists of a thick, strong, round fasciculus, which forms quite an elevation in the median line; it is inserted into the tubercle on the anterior arch of the atlas. The *deep-seated* is broader than, but not so thick, as the superficial.

The POSTERIOR OCCIPITO-ATLANTAL LIGAMENT, Fig. 228 (3), connects the posterior margin of the occipital foramen to the posterior arch of the atlas. It is broad and thin. The vertebral arteries and sub-occipital nerves pass through it. The dura mater adheres closely to its inner surface.

Each condyle of the occipital bone is joined to the corresponding oblique process of the atlas by a CAPSULAR LIGAMENT, Fig. 228 (4,4.) This ligament is much thicker ex-

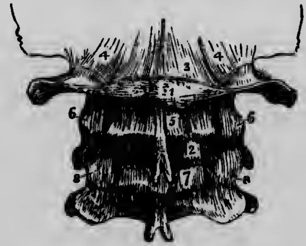
ternally and anteriorly than it is elsewhere. It allows considerable motion to these articulations. A synovial membrane

Fig. 227.

An Anterior View of the Ligaments connecting the Atlas, the Axis, and the Occipital Bone. A Transverse Section has been carried through the Base of the Skull, dividing the Basilar Process of the Occipital Bone and the Petrous portions of the Temporal Bones.—1. The anterior round occipito-atlantal ligament. 2. The anterior broad occipito-atlantal ligament. 3. The commencement of the anterior common ligament. 4. The anterior atlanto-axoid ligament, which is continuous inferiorly with the commencement of the anterior common ligament. 5. One of the atlanto-axoid capsular ligaments; the one on the opposite side has been removed, to show the approximated surfaces of the articular processes (6). 7. One of the occipito-atlantal capsular ligaments. The most external of these fibres constitute the lateral occipito-atlantal ligament.

lines the inner surface of each ligament, and covers the articular cartilage inclosed by the ligament.

Fig. 228.

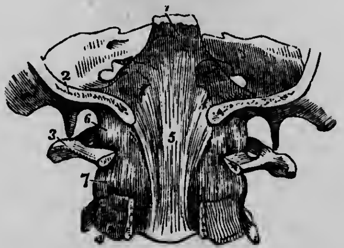


The Posterior Ligaments of the Occipito-atloid, and Atlanto-axoid Articulations.—1. The atlas. 2. The axis. 3. The anterior ligament of the occipito-atlantal articulation. 4, 4. The capsular and lateral ligaments of this articulation. 5. The posterior ligament of the atlanto-axoid articulation. 6, 6. Its capsular ligaments. 7. The first of the ligamenta subflava, passing between the axis and the third cervical vertebra. 8, 8. The capsular ligaments of those vertebræ.

The Lateral Occipito-atlantal Ligament, Fig. 228 (4), connects the transverse process of the occipital bone to the transverse process of the atlas. It is quite a thick, strong, ligamentous cord. By its connection with a ligamentous fasciculus, which is attached to the petrous portion of the temporal bone, a fibrous canal is formed for the transmission of the large vessels and nerves at the base of the skull.

The occipital bone is connected to the axis by four ligaments; three of which are attached to the odontoid process, and one to the body of the axis.

Fig. 229.



The Upper Part of the Vertebral Canal, opened from behind in order to show the Occipito-axoid Ligament.—1. The basilar portion of the sphenoid bone. 2. Section of the occipital bone. 3. The atlas, its posterior arch removed. 4. The axis, the posterior arch also removed. 5. The occipito-axoid ligament, rendered prominent at its middle by the projection of the odontoid process. 6. Lateral and capsular ligaments of the occipito-atlantal articulation. 7. Capsular ligament between the articulating processes of the atlas and axis.

The Occipito-axoid Ligament, or Apparatus Ligamentosus Colli, Fig. 229 (5), is placed beneath the dura mater, and extends from the lower part of the basilar fossa of the occipital bone downwards to the body of the axis, where the central part of it is continuous with the posterior common spinal ligament. The lower part of this ligament may be divided into three fasciculi or bands, two of which are situated laterally, and are continued down to the third or fourth cervical vertebræ.

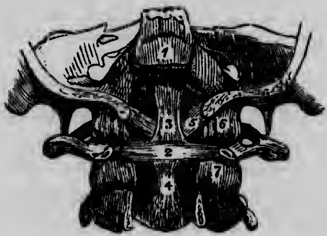
The Odontoid or Moderator Ligaments connect the odontoid process with the sides of the occipital foramen. They consist of thick, round fibrous cords, one on each side, which have an oblique direction from below upwards and

outwards. They have been called moderator or check ligaments, from their regulating the rotatory motion of the head on the axis. What is called the *middle ligament* consists of a few ligamentous fibres that pass from the summit of the odontoid process to the anterior border of the occipital foramen.

The atlas and axis are connected together by five ligaments.

The Anterior, Fig. 227 (4), and Posterior, Fig. 228 (5), Atlanto-axoid Ligaments are placed between the anterior and posterior arches of the atlas and the corresponding portions of the axis. The anterior is attached below, to the base of the odontoid process, and on each side of it, to the body of the axis, where it is continuous with the anterior common ligament. The posterior ligament corresponds to the ligamenta sub-flava; below it is attached to the upper borders of the laminæ of the axis.

Fig. 230.



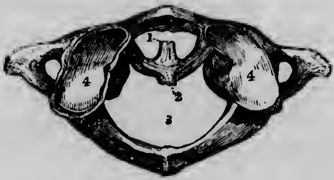
A Posterior View of the Ligaments connecting the Atlas, the Axis, and the Occipital Bone. The Posterior part of the Occipital Bone has been sawn away, and the Posterior Arches of the Atlas and Axis removed. 1. The superior part of the occipito-axoid ligament, which has been cut away in order to show the ligaments beneath. 2. The transverse ligament of the atlas. 3. 4. The ascending and descending slips of the transverse ligament, which have obtained for it the title of cruciform ligament. 5. One of the odontoid ligaments; the other ligament is seen on the opposite side. 6. One of the occipito-atlantal capsular ligaments. 7. One of the atlanto-axoid capsular ligaments.

There are two Capsular Ligaments, Fig. 230 (7), one for the oblique processes on each side. Each is composed of straight and oblique fibres, and is thicker anteriorly than at any other part. They are of sufficient length to admit of rotatory, as well as several other movements, to the head. They are lined by synovial membranes, which

also cover the articular cartilages found on the oblique processes.

The articulation of the odontoid process with the anterior arch of the atlas consists of a small concave facet on the former, and a corresponding convex one on the latter. Both of these are covered with cartilage and synovial membrane; they are also surrounded by a few ligamentous fibres, which form a sort of capsular ligament.

Fig. 231.



A View of the Atlas from above, showing the Transverse Ligament, with Fragments of its Appendages.—1. The space for the odontoid process. 2. The transverse ligament. 3. Space for the spinal cord. 4, 4. Articular processes; on the left one a remnant of the capsular membrane is seen.

Posteriorly, the odontoid process articulates with the Transverse Ligament, Fig. 231 (2). This ligament consists of a strong fasciculus of fibres which are attached to the inner sides of the lateral masses of the atlas. Its connection with the odontoid process is similar to that between the latter and the anterior arch of the atlas, a smooth concave articular facet being found on the anterior surface of the ligament, and a corresponding one on the posterior surface of the process. The synovial membrane, which lines this cavity, extends upwards on the process to near its summit. The ring, that is formed by the parietes of these articulations, has a smaller orifice below than above, being adapted to the shape of the odontoid process, so that the process will be retained *in sitû* after all the other connections between the atlas and axis, or between these and the occipital bone have been cut away. From the upper edge of the transverse ligament a layer of fibres passes upwards, to be inserted into the anterior margin of the occipital foramen; and another layer of fibres from the inferior margin descends to be attached to the axis. The term *cruciform* has been applied to the transverse ligament, including the vertical fibres attached to its two borders.

Dissection of the Articulations of the Pelvis.

The pelvis is articulated above with the vertebral column, and below with the femora. The degree of mobility allowed by these articulations is very different. Between the bones of the pelvis, except between the sacrum and coccyx, no motion is required, unless it be in the female during parturition.

The *sacro-vertebral articulation* is formed by the last lumbar vertebra and the sacrum. With the exception of the sacro-vertebral and ilio-vertebral ligaments, the connecting media are the same as between the different vertebræ.

The Sacro-Vertebral Ligament, Fig. 220 (2), is of a triangular shape, and extends from the transverse process of the last lumbar vertebra to the upper or horizontal surface of the corresponding ala of the sacrum. Its fibres spread out towards the sacro-iliac symphysis.

The Ilio-Vertebral Ligament, Fig. 220 (3), of a triangular form, extends from the transverse processes of the last two lumbar vertebræ to the crest of the ilium. It fills up a notch that would otherwise exist at this point. Sometimes there are two of these ligaments on the same side.

The *sacro-coccygeal articulation* presents two ligaments, one before and the other behind; and a thin *layer of cartilage* placed between the two bones, where a small *synovial sac* is sometimes met with, especially in the female.

The Anterior Sacro-Coccygeal Ligament is composed of irregular fibres, and is much thinner than the posterior.

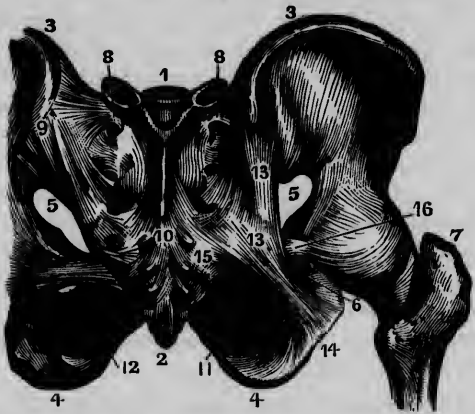
The Posterior Sacro-Coccygeal Ligament, Fig. 232 (10), is quite a thick, strong ligament. It extends downwards over the different pieces of the coccyx, closes in the lower extremity of the sacral canal, and protects the last nervous cords of the medulla spinalis.

The mobility of this articulation is said to be greater in the female than in the male; and in women who have borne children, its mobility is preserved for a much longer period of life than in those who have not. If it were not for the sacro-sciatic ligaments, the motion between the sacrum and coccyx would be greater than it is.

The number of coccygeal articulations vary greatly in

different subjects, and at different periods of life. In the young subject, a thin fibro-cartilage is found between the

Fig. 232.



A Posterior View of the Ligaments of the Pelvis.—1. Base of the Sacrum. 2. The coccyx. 3, 3. The crests of the ilia. 4, 4. The tuberosities of the ischia. 5, 5. The great sciatic notches. 6. The small sciatic notch. 7. The femur. 8, 8. The posterior sacro-iliac ligaments. 9. An oblique fasciculus. 10. The posterior sacro-coccygeal ligament. 11. The obturator ligament. 12. The sub-pubic foramen. 13, 13. The origin of the great sacro-sciatic ligament. 14. Its insertion. 15. The origin of the small sacro-sciatic ligament. 16. Its insertion.

bones, while in the old the joints are most commonly obliterated. The sacrum and coccyx are also in the old generally united by osseous substance.

The *sacro-iliac articulation* is formed by the sacrum and ilium. The articular surfaces, from their shape, have been called the *auricular facets.* The connecting media consist of anterior and posterior fibres, and an intermediate *layer of cartilage*, which adheres very closely to the bones.

The Anterior Sacro-Iliac Ligament, Fig. 233 (7), is composed of a thin layer of fibres, extending transversely from one bone to the other; they are scarcely raised above the contiguous smooth surfaces.

The Posterior Sacro-Iliac Ligament, Fig. 232 (8), consists of several fasciculi, which extend from a rough surface behind the auricular facet of one bone to a corresponding surface on the other. Some of the fibres are oblique, and others

are nearly transverse. One or two of the *oblique fasciculi*, Fig. 232 (9), have been described as distinct ligaments. The ligament is situated deeply in the groove formed between the sacrum and ilium; it requires considerable time and patience to make a satisfactory exposition of all its fibres or fasciculi. A synovial membrane is sometimes found in this articulation, especially in the female, while a soft yellowish substance is sometimes met within it in the male. As it is occasionally desirable to disarticulate the os innominatum, as in making a dissection of the pelvic viscera, the student should be careful to ascertain the exact position of the symphysis, in front, and divide all the fibres of the anterior ligament, when a small scalpel can be carried through the cartilage which connects the two bones forming the joint.

The two following ligaments connect the sacrum and coccyx to the ischium. They enter so largely into the formation of the pelvic parietes, and sustain such important relations to various parts, that the student cannot neglect to obtain a thorough knowledge of them without doing great injustice to himself. They should be carefully studied before he attempts to make a dissection of the pelvis or the pelvic viscera. Their value in the mechanism of the pelvis will be observed the moment that he contrasts an articulated pelvis, composed simply of the bones, with one prepared with these ligaments cleaned and retained *in situ*.

The Posterior or Great Sacro-Sciatic Ligament, Fig. 233 (4), is of a somewhat triangular shape, with the *base* attached to the posterior inferior spinous process of the ilium and to the border of the sacrum and coccyx, and the *apex* to the inner edge of the tuberosity of the ischium and to the ramus of the same bone. The obturator fascia is connected to the anterior or falciform portion of this ligament, which projects a little into the perineum, and serves to protect the internal pudic vessels. The posterior surface of this ligament is occupied by the origin of a part of the gluteus maximus muscle, while the anterior surface is partly free, looking into the pelvic cavity, and partly in apposition with the short ligament. It is perforated by small foramina for the transmission of vessels.

The Anterior or Small Sacro-Sciatic Ligament, Fig. 233 (5), is attached behind to the side of the sacrum and

coccyx, and anteriorly to the spine of the ischium. Its form is triangular, and its direction is nearly transverse. Posteriorly, it is covered principally by the great ligament, with which its fibres are more or less intermingled, especially at its base or near the sacrum. Anteriorly, it is in apposition with the coccygeus muscle.

Fig. 233.

A Section of the Pelvis, showing the Ligaments and Sacro-Sciatic Foramina on the Left inner side, viz: 1. Great sacro-sciatic foramen. 2. Small sacro-sciatic foramen. 3. Sacro-coccygean ligament. 4. Great sacro-sciatic. 5. Small sacro-sciatic. 6. Symphysis pubis. 7. Anterior sacro-iliac ligament. 10. Obturator.

The great and small sacro-sciatic notches, which exist in the osseous pelvis, are by these two ligaments converted into the *great* and *small sacro-sciatic foramina*, Fig. 233 (1, 2). As the spine of the ischium separates the two notches, so the small sacro-sciatic ligament separates the two foramina. The contents of these foramina require particular notice in the dissection of the parts inside of the pelvis and in the gluteal region.

The articulation formed by the bodies of the pubic bones is designated the *symphysis pubis*, Fig. 233 (6). The space between these bones is of a cuneiform shape, the base looking forwards and downwards, and the thin edge backwards and upwards. This space is filled with fibro-cartilage, including sometimes an imperfect synovial sac, especially in the female. The fibro-cartilage is arranged in concentric layers of an elongated oval form; short fibres penetrate and connect them together, except in the centre and posteriorly, where a soft pulpy substance is found, or the synovial sac when present. As the laminæ just fill the circumference of the space between the bones, they are thicker or more numerous in front than behind, where they project so as to form a vertical ridge; some of them may be entirely deficient behind.

Surrounding this intermediate structure, ligamentous fibres extend from one bone to the other. They are named according to their location. Thus, we have quite a thick, strong fasciculus of fibres above, passing from one bone to the other and continuing some distance on their upper borders; this

is named the *superior pubic ligament.* Behind, there are fibres which connect the two bones together; they do not form, however, so thick a layer as the upper and anterior ones do; they constitute the *posterior pubic ligament.* Anteriorly, there is also the same arrangement of fibres, forming the *anterior pubic ligament.* Below, the fibres interlace, and extend downwards on the rami of the pubes, and form the *sub-pubic ligament*, which is of a triangular shape. This ligament rounds off the angle formed by the rami of the pubic bones, and forms the summit of the pubic arch. The symphysis pubis is supposed by some to allow of a slight degree of mobility in parturition. If motion takes place at all, it must be so little as to produce scarcely any appreciable effect in increasing the diameters of the pelvis.

The OBTURATOR LIGAMENT or MEMBRANE, Fig. 233 (10), occupies the obturator foramen. It presents an opening called the *sub-pubic foramen*, Fig. 232 (12), in the upper part, corresponding to the sub-pubic groove in the horizontal ramus of the os pubis, for the transmission of the obturator nerve and vessels. Its surfaces are occupied by the origins of the obturator muscles. This fibrous membrane is a substitute for osseous structure in the parietes of the pelvis, which are probably rather strengthened than weakened by it; it may also yield somewhat in parturition, and thus facilitate the passage of the head of the child through the pelvis. Another advantage said to be derived from it, is that it is lighter than bone would be; the difference, however, between its weight and that of a thin lamella of bone could make no manifest difference.

Poupart's and *Gimbernat's ligaments*, Fig. 220 (6, 7), are formed by the lower border of the tendon of the external oblique muscle, with the addition of some fibres which arise from the anterior superior spinous process of the ilium; they are noticed in the dissection both of that muscle and of the femoral region.

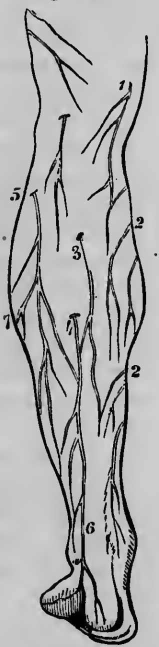
SECT. III.—DISSECTION OF THE BACK OF THE THIGH, AND OF THE HAM.

The back part of the thigh and the popliteal space should be examined at the same time, commencing the dissection above, and extending it down as far as the back of the

leg. With a little attention, the student will be able to ascertain the best position in which to place the limb as he proceeds with the dissection. To expose the long muscles on the back of the thigh, the leg should be extended on the thigh, and the thigh flexed on the pelvis. To remove the skin, an incision may be made through it in the median line of the limb, beginning at the gluteal region and terminating about three or four inches below the knee-joint; but if the anterior part of the thigh has already been dissected, the integument may be removed, by simply reflecting it either from the inner or the outer part of the limb.

The superficial fascia in these regions is merely a continuation of the superficial fascia from the fore part of the thigh and the pelvis. There are no arteries that require any particular notice in this fascia; and the only vein of sufficient importance, and which was not seen in the dissection of the anterior part of the thigh, to be particularly noticed, is the external saphenous.

Fig. 234.



PLAN OF THE CUTANEOUS NERVES ON THE POSTERIOR ASPECT OF THE LEFT LEG.—1. Inner division of the internal cutaneous nerve. 2, 2. Branches of the long or internal saphenous. 3. A branch of the posterior femoral cutaneous; the offset above it in a direct line is a branch of the same nerve. 4, 6. Short or external saphenous nerve. 5, 7. Peroneal cutaneous nerve.

The *external* or *short saphenous vein* is a continuation of the external dorsal vein of the foot. It will be found, in this dissection, extending up the back part of the leg in the median line, and entering the popliteal space to open into the popliteal vein. Sometimes quite a large venous trunk is found going from this vein to the upper part of the thigh, where it unites with a branch of the internal saphenous, or of the deep femoral vein.

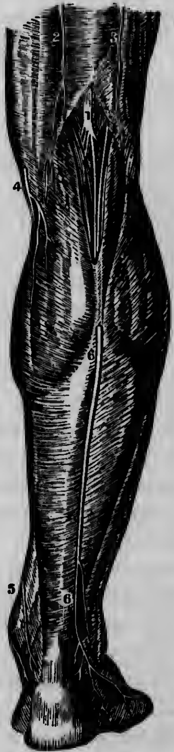
The *cutaneous nerves*, Fig. 234 (2, 2), on the back part of the thigh and in the ham are derived, on the inner side, from the internal cutaneous, and from the internal saphenous, or the obturator nerve; on the outer side, from the external cutaneous; and in the middle, from the posterior femoral cutaneous.

The one derived from the small sciatic, and descending on the back of the thigh, is called the *posterior femoral cutaneous branch*, Fig. 235 (2, 3). It gives off external and internal filaments in its course down the thigh. One of its terminal branches becomes subcutaneous in the popliteal space, and can be traced some distance on the back of the leg. The other terminal branch does not perforate the deep fascia until it reaches the back of the leg, where it usually ends by anastomosing with the external saphenous nerve. The superficial fascia may now be removed, when the *fascia lata* will be exposed. This is continuous above with the gluteal fascia or aponeurosis, on each side with the fascia lata, where it joins the internal and external intermuscular septa, and below with the deep fascia of the leg. It forms a sheath for the long muscles on the back of the thigh, and stretches across the popliteal space, so as to protect the vessels and nerves in that region; near the knee it is strengthened by fibres derived from the tendon of the biceps flexor and the vasti muscles.

The fascia lata should now be divided along the median line, and reflected to each side, so as to expose the parts beneath it. Having removed the fascia lata, the small or lesser sciatic nerve should be traced down the thigh to the back part of the leg. The following muscles may be examined next, taking care not to destroy the great sciatic nerve.

The Biceps Flexor Cruris, Fig. 215 (4, 5), as its name indicates, arises by two heads. The *long head arises* tendinous, in common with the semi-tendinosus, from the posterior and upper part of the tuberosity of the ischium, from the lower part

Fig. 235.



A View of the Internal Popliteal Nerve and some of its Branches on the Right Leg.—1. The internal popliteal nerve. 2, 3. The terminations of the ramus femoralis cutaneus posterior. 4, 5. The internal saphenous nerve. 6, 6. The external saphenous or communicans tibialis.

of which it is separated by a bursa; the *short head arises*, muscular, from the linea aspera and the external intermuscular septum, commencing where the insertion of the gluteus maximus ends, and extending down near to the condyle. The long head and the semi-tendinosus separate from each other about three inches below their common origin. The two heads unite to form a round tendon, which passes downwards and outwards, and is *inserted* by two fasciculi into the head of the fibula. The long external lateral ligament of the knee-joint is placed between these fasciculi; some fibres extend from one of these fasciculi to the fascia of the leg, and some from the other fasciculus to the head of the tibia.

The SEMI-TENDINOSUS, Fig. 215 (6), *arises*, tendinous and muscular, from the tuberosity of the ischium in common with the long head of the biceps, passes at first directly downwards, and then inwards, becoming tendinous a short distance below the middle of the thigh. Its tendon, small and slender, passes around the inner side of the knee-joint, then forwards, and is *inserted* into the tubercle of the tibia. Its tendon, joined with those of the sartorius, gracilis, and semimembranosus, form what has been called the *goose's foot*. The appropriateness of the name of this muscle will be seen when the relative length of its tendon is noticed.

The SEMI-MEMBRANOSUS, Fig. 215 (7, 7), *arises* from the posterior part of the tuberosity of the ischium, in front of the biceps flexor and semi-tendinosus and behind the quadratus femoris, and passes downwards and inwards to the inner and posterior part of the knee-joint, where its tendon divides into three processes, one of which is *inserted* into the aponeurosis that covers the popliteal muscle; another, passing under the internal lateral ligament, is *inserted* into the inner tuberosity of the tibia; the third one forms a part of the posterior ligament of the knee-joint or the ligament of Winslow; this part of it is *inserted* into the external condyle of the femur. The upper tendon is quite long, flat, and aponeurotic; the lower part of it consists of two laminæ, from the opposing surfaces of which fibres arise to form the upper part of the belly of the muscle. The lower tendon is round and very short. By this arrangement of the muscular bellies of the semi-tendinosus and semi-membranosus, the symmetry of the back part of the thigh is preserved, the belly of each

corresponding to the long tendon of the other. These two muscles form the *inner hamstring*, although the sartorius and gracilis are sometimes spoken of as hamstring muscles. The biceps flexor forms the *outer hamstring*. The tendons of these muscles should be studied with reference to the operation of tenotomy. They can be distinctly felt in the living subject, becoming very prominent when the leg is partly flexed on the thigh.

The actions of the three muscles just described are the same as far as flexing the leg on the thigh, or keeping the axis of the pelvis parallel with that of the lower limb, as when standing. When the leg is partly flexed, they can rotate it very little, the biceps outwards, and the other two inwards. Through the connection of the semi-membranosus with the posterior ligament of the knee-joint, it can draw the synovial membrane backwards.

The arteries involved in dissecting the preceding muscles are principally branches of the profunda and popliteal. Those derived from the profunda are the internal circumflex and the perforating branches. The *internal circumflex*, Fig. 217 (8), reaches the back of the thigh by passing, first, between the pectineus and the capsular ligament of the hip-joint, to which it sends a branch through the notch at the bottom of the acetabulum, and then between the quadratus femoris and the adductor magnus. It divides into *ascending* and *descending branches;* the latter of which are distributed in part to the muscles just examined, and to the integument in this region; the former go to the muscles on the back and lower part of the pelvis, the gluteus maximus and the small rotator muscles. This artery anastomoses with the obturator, sciatic, and several others.

The *perforating branches*, Fig. 217 (11, 12, 13), vary in number; being sometimes two and sometimes three, besides the terminal branch of the profunda. The first one perforates the adductor muscles a short distance below the trochanter minor, and, passing backwards partly around the shaft of the femur, divides into ascending and descending branches; some of which terminate in the muscles of this region, and some go to supply the integument. It anastomoses above with the internal circumflex, externally with the external circumflex, and below with the next perforating branch. It usually supplies the femur with its *nutritious artery*. The other per-

forating branches, including the terminal branch, require no particular description. They perforate the adductor muscles, and are distributed in the same manner as the first, of which they are sometimes branches, instead of arising directly from the profunda. The branches of the popliteal, as well as the popliteal itself, will be noticed at another time.

The Great Sciatic Nerve, Fig. 192 (7), has been noticed in the dissection of the parts within the pelvis, and also in the gluteal region. It enters the back part of the thigh, beneath the lower border of the gluteus maximus, and resting on the quadratus femoris, being in a line midway between the tuberosity of the ischium and the trochanter major. For a short distance below the gluteus maximus it is subaponeurotic, having no muscle between it and the integument. It then passes under the long head of the biceps, and continues down the thigh, being inclined a little outwards, to the upper part of the popliteal space, where it divides into the *internal* and *external popliteal nerves.* This division sometimes takes place before it leaves the pelvis; or it may occur at any point after it leaves the pelvis. When it divides in the pelvis, the upper division usually perforates the pyriformis muscle. It is surrounded by a large quantity of areolar tissue, and of adipose substance, if the subject be fat. Its position should be noticed with reference to acupuncture, or injuries of it, from whatever cause. It will be observed that it can be reached below the biceps without passing through any muscle, and also between that muscle and the gluteus maximus.

Having examined the main trunk, it should now be traced from above downwards, to find the branches given off from it. They consist of *muscular* and *articular branches;* the latter go to the knee-joint; two branches are distributed to the semi-membranosus; one to the semi-tendinosus; one to the long head, and one to the short head, of the biceps; and one to the adductor magnus. These nerves, except the one to the short head of the biceps, usually arise just as the sciatic nerve enters the back of the thigh, sometimes coming off from it by a single trunk, and afterwards dividing. The adductor magnus is supplied principally by branches which come from the obturator nerve; the one that comes from the sciatic penetrates the inner border of the muscle some distance below its origin. The branch which goes to the short

head of the biceps sometimes arises with the preceding, and sometimes by itself, lower down. Those that go to the other three muscles, generally run some distance before penetrating them, which they do on their anterior surfaces.

The posterior surface of the *adductor magnus*, Fig. 216 (13), should be noticed so that a clearer idea of the muscle can be obtained than could be, by simply examining it when the anterior part of the thigh was dissected. Its relations to so many parts renders a knowledge of it very important to the student. The obturator externus should also be examined now more thoroughly than could be done before.

The *popliteal space*, and its *boundaries*, Fig. 236 (3), should next be examined. It is somewhat diamond-shaped, the broadest part corresponding to the knee-joint. It is covered in by the integument and a strong *aponeurotic fascia*, which is continued, as was noticed before, from the fascia lata on the back of the thigh. This fascia serves to protect the parts in this space, and, in case of aneurism of the popliteal artery, or of an accumulation of pus beneath it, offers strong resistance, which renders such cases very painful. It is connected laterally, to the condyles of the femur and to the tendons of the muscles. The *upper* part of the space is bounded, on the *outer* side, by the biceps flexor muscle, and on the *inner* side, by the semi-tendinosus, semi-membranosus, and the adductor magnus. The *lower* part has, on the *outer* side, the external head of the gastrocnemius and the plantaris, and on the *inner* side, the internal head of the gastrocnemius. The *anterior* boundary or the *floor* of this space, is formed by the pop-

Fig. 236.

THE SUPERFICIAL MUSCLES OF THE POSTERIOR ASPECT OF THE LEG.—1. The biceps muscle forming the outer hamstring. 2. The tendons forming the inner hamstring. 3. The popliteal space. 4, 4. The gastrocnemius muscle. 5, 5. The soleus. 6. The tendo-Achillis. 7. The posterior tuberosity of the os calcis. 8. The tendons of the peroneus longus and brevis muscles passing behind the outer ankle. 9. The tendons of the tibialis posticus and flexor longus digitorum passing into the foot behind the inner ankle.

liteal fossa of the femur, the posterior part of the knee-joint, and the popliteus muscle, or the aponeurosis which covers it.

The popliteal region generally contains a considerable quantity of areolar tissue and adipose substance, which renders the dissection of its contents difficult, requiring time and patience to do it in a proper manner. The vessels consist of the popliteal artery and its branches, and of the accompanying veins. The nerves are the internal and external popliteal, and their branches.

Fig. 237.

A VIEW OF THE INTERNAL POPLITEAL AND POSTERIOR TIBIAL NERVES IN THE HAM AND THE BACK OF THE LEG.—1, 2, indicate the course of them; the upper part of the external popliteal nerve is seen to the right.

The POPLITEAL VEIN, Fig. 240 (1), is placed between the artery and the integument, so that it will be found in the dissection before the artery. The *posterior* or *external saphenous vein*, Fig. 240 (7), will also be observed entering the popliteal space above the joint, and usually sending off a branch which passes upwards, and anastomoses with the inferior perforating branch.

The large nerves are more superficial, and are situated, except at the lower part of the popliteal space, nearer to its outer border than the artery or vein, and consequently should be looked for in the dissection before those vessels.

The INTERNAL POPLITEAL NERVE, Fig. 237 (1, 2), is the largest of the two divisions of the great sciatic, of which it seems to be a continuation; it is nearly twice the size of the external popliteal nerve. The biceps flexor muscle partly covers it above the knee-joint. It gradually approaches the artery, and finally crosses it and the vein. It takes the name of *posterior tibial nerve* in the leg. It gives off several branches, some of which are *muscular*, one *cutaneous*, and others *articular*.

The *muscular branches* arise from it behind the joint, and

are distributed to the muscles in the upper and back part of the leg. Two of them, quite large, and sometimes arising by a common trunk, go to the heads of the gastrocnemius. They ramify on the anterior surface of each head before penetrating its substance. A smaller one goes to the plantaris, entering its inner and anterior surface; sometimes this is a branch of the preceding nerve. Another branch passes downwards, and gets between the soleus and gastrocnemius muscles, and, after ramifying on the posterior surface of the soleus, penetrates its substance. The last muscular branch goes to the popliteus; after passing down to the lower border of the muscle, turns around it and passing upwards, ramifies on its anterior or deep surface. It sends an articular branch to the tibio-fibular articulation.

The *cutaneous branch* is known by several names, as the *tibial*, *short*, or *external saphenous*, the *posterior cutaneous nerve of the leg*, and the *communicans tibialis*, Fig. 235 (6, 6). It usually arises opposite the articulation, and passing downwards first between the heads of the gastrocnemius, and then on its posterior surface in a small fibrous canal, perforates the deep fascia near the junction of the upper with the middle third of the leg; sometimes it continues lower down before it becomes subcutaneous. It is joined by the communicans peronei nerve, a branch of the external popliteal. The point of union varies greatly, occurring sometimes in the upper part of the leg, and then again not until it has nearly reached the foot. This nerve will be referred to again in the dissection of the back of the leg and the dorsum of the foot, on the outer part of which it terminates.

The *articular branches* are three in number, and correspond to the internal and middle articular branches of the popliteal artery, except there is but one *superior internal articular nerve*, whereas there are two of these arteries; and sometimes this branch, always small, is absent. When present, it passes in front of the popliteal vessels to reach the artery, which it accompanies in its distribution to the joint. The *inferior internal articular branch* arises above the joint, and, passing downwards, at first on the outer side of the vessels, then in front of them, joins the corresponding articular artery, which it accompanies in the rest of its course. It is larger than either of the other articular branches for the knee-joint. The *middle articular branch* arises opposite the articulation, and

proceeds directly to the interior of the joint, perforating the posterior ligament.

The EXTERNAL POPLITEAL or PERONEAL NERVE, Fig. 237, passes downwards along the biceps flexor muscle, in the outer part of the popliteal space, to the point opposite the tibio-peroneal articulation, when it turns outwards, and penetrates the peroneus longus muscle just below the head of the fibula. While in this muscle, or placed between it and the cervix of the fibula, it divides into its terminal branches, the *anterior tibial* and the *musculo-cutaneous*, Fig. 248. These will be described in the dissection of the anterior part of the leg, and the dorsum of the foot. The peroneal nerve is rather more superficial in its course than the internal popliteal. It passes over the external condyle of the femur, and the external head of the gastrocnemius. It gives off *articular* and *cutaneous branches;* of the latter, the *communicans peronei* or the *peroneal saphenous*, is the largest. This usually arises a little above the knee-joint, and passing downwards on the inner side of the peroneal nerve, gets between the gastrocnemius and the deep fascia, which it perforates to unite with the communicans poplitei. Its junction with the communicans poplitei is not constant, and varies very much as to the point at which it takes place. It gives off several small cutaneous branches in its course down the leg. The other cutaneous branch, the *peroneal cutaneous*, given off by the peroneal nerve, descends behind the external condyle, and passing down on the outside of the leg, gives off branches which ascend and descend to supply the integument on that part of the leg. The articular branches correspond to the superior and inferior external articular branches of the popliteal artery. The *superior external articular branch* sometimes arises from the sciatic nerve. It passes downwards in front of the sciatic nerve, when it arises from that nerve, and along the biceps flexor muscle to near the external condyle, then turns outwards above it to be distributed to the joint in company with the corresponding artery. The *inferior external articular nerve* usually has nearly the same origin as the preceding nerve. It passes downwards in the outer part of the popliteal space to a point just below the external condyle, and then turns outwards to be

distributed to the joint in company with the inferior external articular artery.

The POPLITEAL ARTERY, Fig. 238 (1), is a continuation of the femoral. It commences at the lower end of the canal formed by the tendons of the adductores longus and magnus, and passes downwards and outwards, first over the femur, then the posterior ligament of the joint, and lastly the aponeurosis, which covers the popliteal muscle, at the lower border of which, it divides into the posterior tibial and peroneal or fibular. At first, it is to the inner side of the median line of the limb, but gets into it as it descends behind the joint. The *popliteal vein*, Fig. 240 (5), lies behind and a little to the outer side of it above the joint, but directly behind it in the rest of its course. The coats of this vein are very thick, so that when cut it sometimes gapes, and might then be mistaken for the artery. It also adheres very closely to the artery, which should be borne in mind, whenever it is necessary to place a ligature on the latter. The lower part of the artery is partly covered by the heads of the gastrocnemius and the plantaris; the popliteal nerve also crosses this part of it from the outer to the inner side. It has on the sides of it the different parts which form the boundaries of the popliteal space, which are specified above. The relations of the popliteal artery to the knee-joint are interesting, and should be carefully observed. When one limb is placed across the other, as in sitting, the pulsations of the artery are distinctly seen in the movements of the foot, so that the beats of the heart can be counted as accurately, by observing the movements of the foot with the legs crossed, as by placing the fingers on the radial artery in the wrist. There are eight branches given

Fig. 238.

A VIEW OF THE ARTERIES IN THE POPLITEAL SPACE, RIGHT LEG.—1. Popliteal artery. 2. Internal gastrocnemial artery. 3. External gastrocnemial artery. 4, 5. Division of these arteries in the substance of the muscle.

off from the popliteal artery, which require to be noticed. Six of these are articular branches, and two are muscular.

The *superior internal articular arteries*, consist of two. One of these is sometimes called the *great anastomotic artery*, Fig. 213 (20, 21), of the knee. It may arise from the femoral artery as it is passing through the tendinous sheath to become the popliteal; or it may have its origin still higher up. After perforating the adductor magnus, it divides into several branches. One of these passes downwards behind the sartorius muscle, in company with the internal saphenous nerve; another one passes downwards through the substance of the vastus internus muscle, and, reaching the inner border of the tendon of the quadriceps extensor muscle, just above the patella, where it becomes subcutaneous, and crossing transversely to the outer side, along the upper border of the patella, it anastomoses with the superior external articular branch. It sends branches to the anterior surface of the patella. One or two branches are distributed principally to the periosteum on the inner and anterior surface of the femur. One of these sometimes takes the place of the next artery to be described, or terminates by anastomosing with it.

The *lower superior internal articular artery*, Fig. 239 (4), arises just above the internal condyle, passes horizontally inwards and around the condyle, to gain its anterior surface. It sends branches to the patella and to the synovial membrane, and other branches to the integument, and to anastomose with the preceding branch and one or two of the other articular branches.

The *superior external articular artery*, Fig. 239 (5), arises just above the external condyle, and, passing under the biceps flexor muscle, divides into several branches; some of which are muscular, and others are periosteal. The former are ascending branches, and go to the biceps and the quadriceps extensor muscles. The latter are found ramifying on the condyle and the anterior surface of the lower part of the femur, and also on the outer part of the patella. They also anastomose freely with the other articular branches.

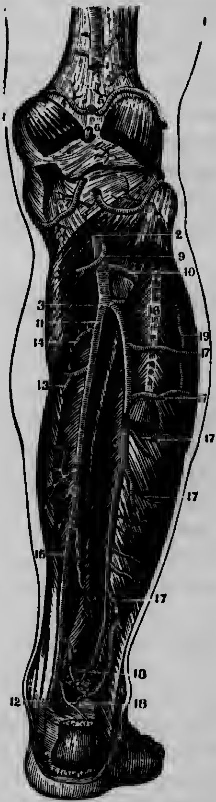
The *inferior external articular artery*, Fig. 239 (8), arises opposite the articulation, and passing horizontally outwards in a line corresponding to the joint, and beneath the tendon of the biceps and the external lateral ligaments, divides into an ascending, a transverse, and a descending branch. The first

passes upwards along the outer border of the patella, and anastomoses with the superior external articular artery. The second, passing transversely below the patella and between the ligamentum patellæ and the joint, anastomoses with the inferior internal articular artery; it also sends small branches to the fat and areolar tissue beneath the ligamentum patellæ. The last one anastomoses with the anterior recurrent tibial, a branch of the anterior tibial artery.

The *inferior internal articular artery*, Fig. 239 (7), arises opposite to the preceding artery, and passing downwards and inwards around the internal tuberosity of the head of the tibia, and beneath the tendons of the muscles which form the inner hamstring, and the internal lateral ligament of the knee-joint, it turns upwards towards the patella. It anastomoses with the preceding artery beneath the ligamentum patellæ, and also with the superior internal articular arteries.

The *middle articular artery*, or the *azygos artery*, Fig. 239 (6), arises from the forepart of the popliteal artery, and passes directly through the posterior ligament, to be distributed to the synovial membrane, the areolar tissue, and the crucial ligaments within the knee-joint; some of its branches penetrate the lower extremity of the femur.

Fig. 239.



A View of the Arteries on the Back of the Right Leg. The Muscles have been removed so as to display the Vessels in their whole length.—1. The popliteal artery, cut off so as to show the articular arteries. 2. Lower end of the same artery on the popliteus muscle. 3. Point of bifurcation into the posterior tibial and peroneal. 4. Lower superior internal articular artery. 5. Superior external articular artery. 6. Middle articular artery. 7. Inferior internal articular artery. 8. Inferior external articular artery. 9. Branch to the head of the soleus muscle. 10. Origin of the anterior tibial artery. 11. Origin of the posterior tibial artery. 12. Point where it passes behind the internal annular ligament to become the plantar. 13, 14, 15. Muscular branches. 16. Origin of the peroneal artery. 17, 17. Muscular branches. 18, 18. Anastomosis of the posterior tibial and peroneal arteries near the heel. 19. Muscular branch from the anterior tibial.

Instead of one middle artery, there may be several smaller ones going to supply the same parts. Like those which have been described above, it may take its origin from some one of the other articular arteries; all the arteries around the knee-joint vary more or less in their origin, and also in their size. The patella is the centre of their anastomotic connections.

The *gastrocnemial arteries*, Fig. 238 (2, 3), arise from the back of the popliteal artery, nearly opposite the articulation, and passing downwards are distributed, one to each of the heads of the gastrocnemius. They are usually larger than the articular branches. They correspond to muscular branches given off from the popliteal artery, above the knee-joint, to be distributed to the muscles in the lower part of the thigh.

SECT. IV.—DISSECTION OF THE POSTERIOR AND THE INNER PART OF THE LEG.

To dissect the posterior part of the leg, the integument may be removed by making an incision from the popliteal space along the median line to the heel, and thence along both the inner and outer borders of the plantar surface of the foot to a point on each side below the malleolus. From this incision the skin can be reflected externally and internally sufficiently to expose all the parts in this region. The foot should be flexed on the leg so as to make the fascia, as well as the muscles to be dissected, tense. Although it is convenient to describe, at this time, the parts which correspond to the subcutaneous surface of the tibia, it is not necessary that the integument which covers this surface should be removed in connection with that on the back of the leg. It is better that the student should dissect specially for the *internal saphenous vein* and *nerve*, as there is nothing else of any importance on the inner part of the leg. The vein, if injected, or filled with blood, is easily found and traced; but it is much more difficult to find the nerve, unless it was preserved when the dissection of the anterior part of the thigh was made. To dissect them on the leg, it is immaterial whether the subject be placed on the back or on the face; if on the back, the integument can be reflected from behind forwards, and the dissection can be made in connection with the back of the leg.

Having reflected the integument from the incision made in the median line to a line corresponding to the fibula and external malleolus on the outer side, and to the inner angle of the tibia and internal malleolus on the inner side, the cutaneous vessels and nerves should be examined. If it be decided to dissect the internal saphenous nerve and vein in connection with the back of the leg, then the internal flap must be raised as far as the anterior angle or spine of the tibia. Special care is requisite in raising the integument that the superficial fascia be left in order that the cutaneous vessels and nerves may not be injured or destroyed before they have been dissected.

There are no arteries in the superficial fascia that require particular notice.

The veins to be examined in the superficial fascia are the two saphenous, external and internal. The latter was dissected in the upper part of its course in connection with the thigh, and the former, with the popliteal space. They both commence on the dorsum of the foot, and are subcutaneous to within a very short distance of their termination, the one in the femoral, and the other in the popliteal vein. They communicate freely with each other on the leg, and sometimes the external joins the internal instead of the popliteal. They contain very few valves, which may contribute to the formation of varix, and also tend to prevent the obliteration of the veins, as they can, in the absence of valves, more readily empty themselves by means of collateral branches; the internal has from *two* or *three* to *six valves*, and the external only *two*.

The INTERNAL SAPHENOUS VEIN, Fig. 208, arises by the internal dorsal vein of the foot, passes backwards and upwards on the inner part of the dorsum, and in front of the ankle-joint to the anterior part of the internal malleolus, and thence along the inner angle of the tibia to the internal and posterior part of the knee-joint. In this part of its course it receives branches from both sides of it. In the foot it communicates with the deep plantar vein, and receives the superficial veins of the inner part of the plantar portion of the foot, including the internal calcaneal veins. Sometimes the last-named veins form a trunk which passes upwards behind the internal malleolus, and there unites with the saphenous.

From the knee to the saphenous opening in the fascia lata, the internal saphenous was described in connection with the anterior part of the thigh. Below the knee it is accompanied by one of the terminal divisions of the internal saphenous nerve. This is the longest vein in the body.

The EXTERNAL or POSTERIOR SAPHENOUS VEIN, Fig. 240 (7), commences by the external dorsal vein of the foot, which communicates by quite a large branch with the internal dorsal vein; thus a sort of an arch is formed, from the extremities of which the saphenous veins take their origin. It passes backwards and upwards around the lower and posterior surface of the external malleolus to the outer border of the tendo-Achillis; it then ascends on the back of the leg over the gastrocnemius muscle to the popliteal region. It receives on the dorsum of the foot, at the outer part of the ankle-joint, the small veins which correspond to those received by the internal saphenous. It is accompanied by the external saphenous nerve which the vein crosses twice in its course, passing between it and the skin.

There are several cutaneous nerves distributed to the integument on the back and inner part of the leg. They have been noticed incidentally in connection with the dissection of the thigh and the popliteal region.

The COMMUNICANS TIBIALIS, a branch of the internal popliteal, and the COMMUNICANS PERONEI, a branch of the external popliteal, Fig. 235, were observed in the dissection of the popliteal space. They are very regular in their origin and in the upper part of their course, but not so in the latter part of their course. Sometimes the peroneal communicans merely sends a branch to join the tibial communicans, and then again it terminates in it. They vary as to the point where they perforate the deep fascia, sometimes not doing it until they reach the lower part of the leg; the distribution, however, is the same. The tibial communicans, after it has received the anastomosing branch from the peroneal communicans, or has been joined by the nerve itself, is by some called the *external saphenous*. Fig. 235 (6, 6). It descends on the outer side of the tendo-Achillis in company with the external saphenous vein, to a point behind the external malleolus, where it sends off *external calcaneal branches* to the integument on the heel; it then continues forwards below the

malleolus to the outer part of the dorsum of the foot, and divides into *two branches*, one to supply the external part of the little toe, and the other, the contiguous surfaces of the same toe and the fourth toe; the last-named division receives an anastomosing branch from the musculo-cutaneous nerve. When the peroneal communicans continues down the leg, it usually terminates in supplying branches to the outer part of the heel; it gives off branches to the integument as it passes down the leg. It also frequently sends off a *malleolar branch* which, passing over the external malleolus, either anastomoses with, or takes the place of, a branch from the musculo-cutaneous.

The INTERNAL SAPHENOUS NERVE, Fig. 212 (6), Fig. 234 (2, 2), gives off a branch named the *patellar* on the inner side of the knee, which perforates the sartorius muscle, and passing downwards a short distance above the tendon of the sartorius, turns outwards and divides into *ascending*, *middle*, and *descending branches*, which ramify on the anterior surface of the patella, the ligamentum patellæ, and the forepart of the tibia. After giving off the patellar branch, the saphenous passes over the tendon of the gracilis to join the internal saphenous vein, which it accompanies to the foot. Its connection with the vein is such as to render the dissection of either of them somewhat difficult, as it twines around the vein, splits and runs a short distance on each side of it, and then unites again. In its course down the leg it sends branches, both externally and internally, to the integument. The internal filaments are short, and anastomose in the upper and posterior part of the leg with filaments derived from a cutaneous branch given off from the internal saphenous just before it enters the tendinous canal formed by the adductor magnus, or from a cutaneous branch given off by the obturator nerve, which then takes the place of the one from the internal saphenous; in the lower part they anastomose with filaments from the external saphenous nerve. The external filaments are long, and descend obliquely outwards in front of the tibia. About three or four inches above the ankle, the internal saphenous divides into a *posterior* and an *anterior branch;* the former passes directly downwards in front of the internal malleolus to the inner part of the foot, extending as far as the sole, and giving filaments in its course to

the integument on each side of it; the anterior branch continues to accompany the saphenous vein to the dorsum of the foot, giving branches to the ankle-joint and to the skin on the foot.

The *posterior femoral cutaneous branch* of the small sciatic, Fig. 234 (3), terminates in filaments sent to the integument on the back of the leg, and also to anastomose with the external saphenous nerve.

The *peroneal cutaneous branch*, Fig. 234 (5, 7), of the external popliteal nerve is distributed to the integument on the outer part of the leg. Having completed the dissection of the vessels and nerves, the superficial fascia should now be removed to expose the deep fascia.

The *deep fascia* on the back of the leg is continuous with the deep fascia in the popliteal space, where it is strengthened by fibrous expansions from the tendons of the biceps, the semi-tendinous, the gracilis, and the sartorius. It is attached laterally, to the fibula on the outer side, and to the inner angle of the tibia on the inner side; below, it is connected to the internal annular ligament of the ankle. There is *another fascia* on the back of the leg, which separates the superficial from the deep-seated layer of muscles. This will be noticed when it is reached in the course of the dissection.

The *internal annular ligament*, Fig. 241 (14), arises from the margin of the internal malleolus, and is inserted into the internal side of the os calcis and the plantar aponeurosis. It spreads out so that it is much broader below than above. From its deep surface septa proceed inwards, to form several fibrous canals or sheaths for the tendons of the deep muscles of the back of the leg, and also for the posterior tibial nerve and vessels. The use of the fascia just described is to protect the parts beneath it, and to form for the muscles sheaths, which increase their power of contraction; the annular ligament keeps the tendons which pass beneath it in their proper position.

The three following muscles constitute the superficial layer on the back of the leg. They are large, except the plantaris, and easily dissected. Two of them, as will be observed, arise from the femur above the articulation of the knee, and the third one arises from both bones of the leg, while they all are inserted into the os calcis.

The GASTROCNEMIUS or GEMELLUS, Fig. 236 (4, 4), arises by two heads, an external and an internal. The internal head, sometimes called the *gemellus internus*, is longer and larger than the external. It *arises*, muscular and tendinous, from a depression and a rough surface around it on the outer and upper part of the internal condyle, and from a ridge that is formed by the bifurcation of the linea aspera; the external head or *gemellus externus arises* from the outer and back part of the external condyle, and from a ridge above it. The tendon of each head is quite thick and stout at its origin, but spreads out as it descends behind the articulation of the knee and on the side of the popliteal space, to join the one on the opposite side. The fibres which go to form the principal part of the belly of the muscle, have their origin on the anterior surfaces of these tendinous expansions. Most of the fibres which arise directly from the bone, end in a tendinous substance which is placed in the median line of the muscle, while those which arise from the tendon pass downwards to be inserted into the posterior surface of a broad aponeurotic tendon, which gradually becomes narrower until it *ends* in the tendo-Achillis. The part of the belly formed by the inner head, is much thicker than that formed by the outer head. A synovial sac is frequently found between each head, most commonly the left one only, and the corresponding condyle; in some instances they communicate with the knee-joint. Sometimes a sesamoid bone, or fibro-cartilage, is met with in one or both of the heads behind the condyle. The posterior surface of the gastrocnemius is convex, while the anterior is flattened. It forms a considerable portion of the calf of the leg. The tendo Achillis will be noticed in connection with the soleus.

The next muscle to be dissected is the plantaris. This is so small, and so closely connected to the gastrocnemius, that the student is very liable to overlook it unless his attention has been directed to it.

The PLANTARIS consists of a small muscular belly terminating in a long slender tendon, the longest in the body. It *arises* from a rough surface above the external condyle, and from ligamentous fibres placed behind it, and passes downwards on the inner side of the external head of the gastrocnemius, which partly covers it, and of which it frequently

seems to be a part, to end about three inches below its origin, in a small tendon which disappears beneath the gastrocnemius, to appear again on the inner side of the tendo-Achillis, which it accompanies to the os calcis, into which it is *inserted*, either on the inner side of, or anterior to that tendon. The upper part of the tendon is placed between the gastrocnemius and soleus, having, with the muscular part, a direction somewhat oblique from above downwards, and from without inwards. This muscle is sometimes wanting, or its tendon may terminate in condensed areolar tissue before it reaches the heel.

The SOLEUS, Fig. 236 (5, 5), is placed beneath the gastrocnemius, which must be partly or wholly raised to expose it. This may be done by detaching both heads at their origin; or by cutting across the muscle just below the junction of its two heads; or by simply detaching the internal head, separating the muscle from the parts beneath it, and then turning it outwards. It is immaterial which plan is adopted, provided the different muscles are preserved so that they can be replaced after the dissection has been completed, for the purpose of studying their relations to each other, and more particularly to the vessels and nerves in this region. The soleus has *three origins*. The *first* is by a strong tendon from the posterior part of the head of the fibula, and from the outer border and the posterior surface of the upper two thirds of its body; the *second* is from an oblique line, called the linea poplitei, on the posterior surface of the upper part of the tibia, and from the middle third of the inner angle of the same bone; the *third* one is from a tendinous arch extending from the head of the fibula to the commencement of the linea poplitei. It is beneath this arch that the vessels and nerves pass from the popliteal space to the back of the leg, to get between the superficial and deep-seated layers of muscles, and by which they are protected from pressure by the action of the muscles between which they are placed. The fibres arising in the manner above mentioned pass downwards, some of them more or less obliquely, to be inserted into the anterior surface of a tendinous expansion, which spreads out to form a considerable portion of the posterior surface of the muscle. This tendon, like the lower one of the gastrocnemius, diminishes in breadth, but in-

creases in thickness as it passes downwards to *end* in the tendo-Achillis. The muscular belly of the soleus is prolonged some distance further down than that of the gastrocnemius. The opposing surfaces of these muscles are perfectly fitted to each other, and are separated only by loose, delicate areolar tissue, which allows the one to glide on the other with the greatest facility. Taken together, they form the calf of the leg; the upper part being formed mostly by the gastrocnemius, the lower part by the soleus. Perhaps no two muscles in the body present a more beautiful appearance than these two, when fully developed and properly dissected. This is owing not only to their perfect symmetry of form, but to the manner in which the muscular and tendinous structures are distributed in them.

The TENDO-ACHILLIS, Fig. 236 (6), is the tendon of insertion common to the gastrocnemius and soleus. It is from three to four inches in length, being the largest and strongest tendon in the body. It is *inserted* into the lower part of the posterior extremity of the os calcis, being separated from all the upper and posterior surface of the bone by a synovial sac. It is separated from the posterior tibial vessels and nerve, which are placed beneath it, by areolar tissue and a dense fibrous membrane. The distance between it and the vessels allows of its being divided without any risk to them.

The action of the gastrocnemius and soleus will be the same, as far as the ankle-joint is concerned, as both of them pass over it; the former, as it passes over the knee-joint, can act on the leg as well as the foot, or on the thigh when the foot is made the fixed point. The office which they are required to perform demands that they should be powerful muscles. Making their origin the fixed point, they are capable of raising the entire body, as is done at every step that is taken in walking. When their attachments, and the relations which they sustain to the joints that they pass over, are understood, there will be no difficulty in understanding their actions. The action of the plantaris is so little that it can produce no marked effect, and as it is frequently absent, or when present, void of any fixed attachment below, must be unimportant.

The three muscles just noticed may now be removed for the purpose of examining the *fascia*, which separates them

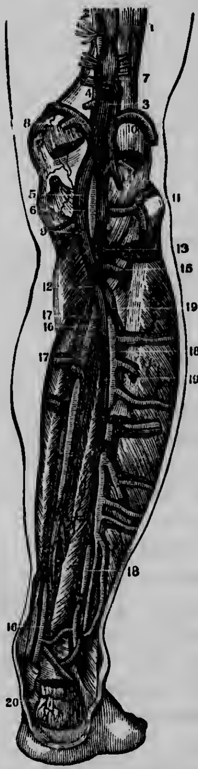
from the posterior tibial vessels and nerve and the deep layer of muscles. It is an extension of the one that covers the popliteus muscle, downwards to the foot, where it is blended with the internal and external annular ligaments. Laterally, it is attached externally to the fibula, and internally to the inner border or angle of the tibia. It binds down the muscles which are placed under it; and should be observed with reference to the formation of pus beneath it, and the direction it would be most likely to take. It shows the depth of the posterior tibial artery, and hence may be made an important guide for finding that vessel. When this fascia is removed, the following parts will be exposed:—

The popliteal artery will be seen at the lower border of the popliteus muscle, dividing into the anterior and posterior tibial arteries. The former is appropriated to the anterior part of the leg and the dorsum of the foot; the latter is distributed mainly to the back of the leg and the plantar portion of the foot.

The Posterior Tibial Artery, Fig. 239 (11, 12), commences at the bifurcation of the popliteal at the lower border of the popliteus muscle, and extends down the leg to the groove formed by the internal malleolus and the os calcis, where, beneath the internal annular ligament, or the origin of the abductor pollicis, it divides into the external and internal plantar arteries. At first it is inclined inwards for a short distance, after which it has a vertical direction to its termination. In the upper part of its course it rests on the tibialis posticus, in the middle on the flexor longus digitorum communis, and in the lower part it is in apposition with the tibia and the ankle-joint. In the upper two-thirds of its course it is covered by the gastrocnemius and soleus muscles; in the lower third it lies along the inner side of the tendo-Achillis and the os calcis, and is covered only by the integument and the different fasciæ of this region, including the internal annular ligament. It is placed midway between the internal malleolus and the os calcis, being separated from the former by the tendons of the flexor longus digitorum communis and the tibialis posticus, and from the latter by the tendon of the flexor longus pollicis. The posterior tibial nerve is at first on the outer side, then behind, and in the lower part of the leg on the inner side of it, where it is separated from the artery by one of the venæ comites.

The depth and central position of the upper half or two thirds of the posterior tibial artery, and the same is true of the peroneal artery, as will be seen, renders it one of the most difficult arteries in the body to be reached in the living subject for the purpose of applying a ligature to it.

Fig. 240.



The posterior tibial artery gives off several branches in its course down the leg. The first one to be noticed is the *internal recurrent branch.* This passes round the inner border of the tibia, then upwards to the internal tuberosity of that bone, where it anastomoses with the inferior internal articular branch of the popliteal artery. The next branch to be observed is the *nutritious artery* of the tibia. This enters the nutritious foramen, and is distributed to the internal lamellæ of the bone, including the medullary membrane. It is remarkable for its large size as compared with other arteries of this class. Sometimes it is a branch of the anterior tibial artery. Before entering the bone, the nutritious artery usually gives off one or more muscular branches. The next branch to be examined is one of the principal arteries of the leg.

The Peroneal Artery, Fig. 239 (16, 18), arises from the posterior tibial usually about an inch below the bifurcation of the popliteal artery, and passes

The Arteries and Deep-seated Veins on the Back of the Right Leg.—1. Popliteal vein. 2. Popliteal artery. 3, 4. Vein and artery in their relative position on the back of the knee-joint. 5. Popliteal vein on the inner side of the joint. 6. Popliteal artery to the outer side and beneath it. 7. Posterior or short saphenous vein. 8, 9. Internal articular vessels, both arteries and veins. 10, 11. External articular vessels, both arteries and veins. 12. Junction of the peroneal and posterior tibial veins. 13. A venous branch from the anterior tibial vein. 14. A vein from the gastrocnemius. 15. Anterior tibial artery going through the interosseous ligament. 16, 16. Posterior tibial artery. 17, 17. Its two venæ comites. 18, 18. Peroneal artery. 19, 19. Its two venæ comites. 20. Vessels on the heel.

at first obliquely downwards and outwards, to penetrate the flexor longus pollicis muscle, in which, or between it and the fibula, it extends vertically to within a short distance of the ankle-joint, where it divides into the posterior and anterior peroneal branches. Between its origin and the flexor longus pollicis, it is placed between the soleus behind and the tibialis posticus in front, and gives off in this part of its course branches to those muscles; a little lower down it supplies a *nutritious branch* to the fibula; and still lower, it sends quite a large branch to join the posterior tibial artery; this anastomosing branch passes transversely, or nearly so, across the interosseous ligament; sometimes it is met with very large; when this occurs, the posterior tibial is usually quite small above its junction with this branch of the peroneal artery. Besides those named, the peroneal artery sends branches to the peronei muscles, and to the periosteum on the fibula. The *anterior peroneal branch* perforates the interosseous ligament, and thus gets into the lower part of the anterior interosseous fossa, where it anastomoses with the external malleolar branch of the anterior tibial artery. This is an interesting anastomosis, on account of the large size which this branch of the peroneal artery sometimes presents. It occasionally takes the place of the anterior tibial artery in supplying the arteria dorsalis pedis. It sends small branches to the peroneus tertius muscle and to the ankle-joint, including the articulation between the tibia and fibula. The *posterior peroneal branch* passes down behind the external malleolus, and over the ankle-joint, to reach the outer posterior part of the os calcis, on the surface of which it ramifies, anastomosing with branches of the posterior tibial, external plantar, and the anterior peroneal, or external malleolar branch. The integument and adipose substance on the bottom of the heel are supplied principally from this branch.

The DEEP-SEATED VEINS, Fig. 240, on the back of the leg, consist of venæ comites, which accompany the arteries. Those which accompany the peroneal artery are usually larger than those accompanying the posterior tibial. The artery is generally placed between its venæ comites, between which frequent communications take place across the artery.

The deep-seated veins on the back of the leg unite to form the popliteal vein.

The Posterior Tibial Nerve, Fig. 237, is a continuation of the internal popliteal, and commences at the lower border of the popliteus muscle, where it is placed on the inner side of the posterior tibial artery; as it descends in company with the artery it crosses over to the outer side of it, and continues in this position to the space between the internal malleolus and the os calcis, where it divides into the external and internal plantar nerves. In its course on the leg it gives off branches to the deep layer of muscles and to the integument on the heel. The nerve for the flexor longus pollicis accompanies the peroneal artery to a short distance above the ankle-joint. It usually arises by a common trunk with the branch for the flexor longus digitorum communis. The branch for the tibialis posticus arises a little distance below the knee-joint, and a little higher than the origin of the branches for the other muscles; it penetrates the muscle near its middle, having sent filaments to it in its course to this point. The internal calcaneal branches arise by a single trunk behind the ankle-joint, winds around the os calcis, on its inner side, to reach the integument and adipose substance on its lower surface, where it divides into a branch which goes to the posterior part of the heel, and one that goes to the anterior part. The relations of the posterior tibial nerve to the muscles are the same as those of the artery which it accompanies. The deep layer of muscles which are next to be dissected consist of four. The first one, or popliteus, is covered by an aponeurosis or fascia, by the removal of which the muscle will be exposed. To separate the three muscles below this from each other, it is sometimes better to find their tendons first, and then trace each one upwards. It is not unfrequently with difficulty that any line of separation can be found between the upper and middle portions of these muscles, unless it is followed up from their tendons below; this is more especially the case with the tibialis posticus and the flexor longus digitorum communis.

The Popliteus, Fig. 241 (6), is a flat, triangular-shaped muscle, placed behind and below the knee-joint. It *arises* by a round thick tendon from a depression on the outer surface of the external condyle of the femur, just below the origin

of the external head of the gastrocnemius, and the upper attachment of the external lateral ligament; it passes downwards and backwards beneath the external lateral ligament, and behind the outer part of the articulation, to the upper part of the tibia, into the posterior surface of which it is *inserted*, above an oblique ridge named the linea poplitei. Its tendon is connected to the external semilunar cartilage by ligamentous fibres, and also to the synovial membrane, by which it is partly surrounded, and through which connection a communication is sometimes found to exist between the articulation of the fibula with the tibia, and the knee-joint. The action of the popliteus is to assist the hamstring muscles in flexing the leg on the thigh; or it may flex the thigh on the leg; it may also rotate the tibia slightly, or the femur when the tibia is fixed. By its connection with the semilunar cartilage, it may fix it in its proper place.

The FLEXOR LONGUS DIGITORUM COMMUNIS PEDIS, Fig. 241 (7), *arises* from the posterior surface of the tibia, commencing just below the insertion of the popliteus and the origin of the soleus, and extending down to within three or four inches of the ankle; it also has some fibres arising from the aponeurosis on the tibialis posticus, and from intermuscular septa. From this origin the fibres pass obliquely backwards and inwards, to end in a tendon which descends to a groove behind the internal malleolus, where it is covered and fixed in its place by the internal annular ligament, and separated from the tendon of the tibialis posticus by a process of the annular ligament. It is surrounded by a synovial membrane which extends some distance above and below the groove. From this point it is directed forwards and a little outwards, to pass through a groove in the astragalus, and also one in the os calcis, when it enters the sole of the foot, where it is first joined by a slip from the tendon of the flexor longus pollicis, and next by the musculus accessorius; it now divides into four tendons, one for each of the four smaller toes. Each tendon passes through a fibrous sheath lined by synovial membrane. This sheath corresponds to the under surface of the first and second row of phalanges. Each contains also one of the tendons of the flexor brevis digitorum communis, each of which is slit opposite the base of the second phalangeal bone, for the transmission of the corresponding tendon

of the long flexor, as it passes forwards, to be *inserted* into the base of the last phalangeal bone.

The Flexor Longus Pollicis Pedis, Fig. 241 (9), is placed to the outer side of the preceding muscle, from which it is partly separated by the tibialis posticus. It *arises* from the lower two-thirds of the fibula, from the aponeurosis which covers the tibialis posticus, and from the interosseous membrane near the lower end of the fibula, and also from a fibrous septum between it and the peronei muscles. The fibres pass obliquely downwards and inwards, to end in a tendon which descends to a groove first on the inner side of the astragalus, and then of the os calcis, being kept by a strong fibrous sheath, firmly applied to these bones; from this point it is continued into the sole of the foot, and through it to the base of the last phalangeal bone of the great toe, into which it is *inserted.* Its tendon crosses above that of the long common flexor of the toes, and gives to it a tendinous slip; in the latter part of its course, it is placed between the bellies of the short flexor of the great toe. Opposite the internal malleolus, it is separated from the tendon of the long common flexor of the toes and the tendon of the tibialis posticus, by the posterior tibial vessels and nerve. The peroneal vessels are placed between its origin from the fibula, and its origin from the aponeurosis on the inner side of that bone. Its tendon passes very nearly through the whole muscle. Its action is to flex the great toe, and, having

Fig. 241.

The deep Layer of Muscles of the Posterior Tibial Region of the Left Leg.—1. The lower extremity of the femur. 2. The ligamentum posticum Winslowii. 3. The tendon of the semi-membranosus muscle dividing into its three slips. 4. The internal lateral ligament of the knee-joint. 5. The long external lateral ligament. 6. The popliteus muscle. 7. The flexor longus digitorum. 8. The tibialis posticus. 9. The flexor longus pollicis. 10. The peroneus longus muscle. 11. The peroneus brevis. 12. The tendo-Achillis divided near its insertion into the os calcis. 13. The tendons of the tibialis posticus and flexor longus digitorum muscles, just as they are about to pass beneath the internal annular ligament (14) of the ankle; the interval between the latter tendon and the tendon of the flexor longus pollicis is occupied by the posterior tibial vessels and nerve.

done this, to extend the foot on the leg, and to adduct the foot.

The TIBIALIS POSTICUS, Fig. 241 (8), is situated in the middle of the interosseous fossa, or rather occupies a large portion of it, except at the lower part, where it has become tendinous. It *arises* from both bones of the leg, and from the interosseous membrane; from the fibula, it arises between the origin of the soleus muscle and the outer malleolus, from the tibia, below the linea poplitei, and from nearly the whole of the posterior surface of the interosseous membrane; it also arises from the intermuscular septa, which separate it from the two preceding muscles. The fibres, which arise from these different points, pass downwards to end in a tendon which extends nearly the whole length of the muscle, occupying the central part of it. This tendon passes between that of the flexor longus digitorum communis and the tibia, to get into a fibrous canal above and behind the internal malleolus, and to the inner side of the tendon of the last-named muscle; it then continues obliquely forwards and is *inserted* into the scaphoid and the internal and middle cuneiform bones; sometimes some fibres can be traced from it to the base of the metatarsal bone of the great toe, and also to the external cuneiform bone. A sesamoid bone, or fibro-cartilage, is very frequently found in its tendon just behind its insertion into the scaphoid bone. A synovial membrane is placed between this sesamoid body and the scaphoid bone. The upper end of the muscle is notched for the passage of the anterior tibial vessels. Its action is to extend the foot on the leg; it will also invert the plantar surface of the foot by elevating its inner border; with the long flexor muscles of the toes it may act as a substitute for the gastrocnemius and soleus in case the tendo-Achillis has been injured. It also assists in steadying the foot in standing or walking.

Having completed the dissection of the back of the leg, the student should *review* what he has been over, including in this review the popliteal space. He should carefully *examine* the *deep fasciæ* to see in what manner they would limit or favor in any particular direction, the extension of collections of pus. He will notice that pus, collected beneath the deep fascia of the popliteal space, might extend to the foot without encountering any obstruction from fascia; and also that in en-

tering the leg it would pass down in the sheath of the superficial layer of muscles; or, if it should form beneath the fascia which covers the deep layer of muscles, it might pass under the internal annular ligament and enter the sole of the foot. Thus it will be seen that the cavity formed by the sheath of the superficial layer of muscles communicates with that formed by the fascia lata of the thigh, while that formed by the sheath of the deep layer communicates with that formed by the plantar aponeurosis.

He should *examine* the different *arteries* of this region, and study their relations to prominent points which can always be seen or felt in the living subject, and by which he will be enabled at any time to locate any one of these vessels; and also, *such points* as will serve for *guides* in finding either one of the arteries in case he should ever have occasion to ligate them in his practice. Take, for example, the posterior tibial artery two or three inches below its origin; he should carefully examine its relations to the gastrocnemius and soleus muscles, in order to determine whether it could be reached better by cutting directly upon it through those muscles, or by detaching the soleus from the tibia or fibula, and then following the fascia which separates the superficial from the deep layer of muscles. He has already seen in the dissection of these parts that this fascia covered the artery; he has also seen the position of the nerve, so that he would be able to take this into consideration in deciding the best way to reach the artery without injuring the nerve. He should likewise study the relations of the same artery lower down; and, also, the peroneal artery. The *position* of the *tendons* of the long muscles of the foot as they pass through the sulcus formed, on the inner side by the internal malleolus, and on the outer side by the tendo-Achillis and the os calcis, should receive special attention. It may happen to him some time that he will have occasion to divide one or more of these tendons. A short time devoted to the study of these parts, now they are before him, may prove to be of immense use to him at some future time, and he cannot neglect this opportunity to acquire this knowledge without doing himself great injustice, as well as those who will have a right to demand of him the application of it to themselves.

Sect. V.—Dissection of the Anterior and Outer Parts of the Leg, and the Dorsum of the Foot.

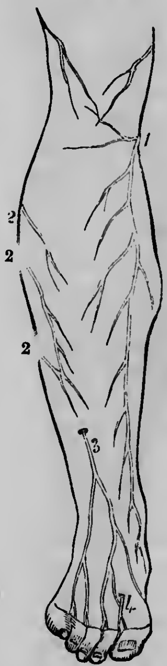
As there is so little on the dorsum of the foot that is not found on the leg, while almost every thing to be dissected on the leg, such as fascia, muscles, vessels, and nerves, not only extend to, but pass over the dorsum of the foot, we think it is better to make but one dissection of these regions. Nor is the number of the parts to be examined so great that the student cannot, if proper means be employed to preserve the subject from drying or decomposing, dissect them in a satisfactory manner while they are in a suitable condition for this purpose. There is, perhaps, more danger to be apprehended from the parts drying and becoming hard on the foot, than of their decomposing, especially if a strong solution of chloride of zinc has been used as an antiseptic; this can be prevented only by the constant use of wet-cloths kept applied to the limb during the intervals of dissecting. The foot should be extended on the leg, and kept in this position by means of hooks; in dissecting the muscles it will be necessary, not only to extend the foot, but to abduct it in dissecting the tibialis anticus, and adduct it in exposing the peronei muscles.

To remove the integument a vertical incision may be made, commencing at the knee and extending it down the leg a little to the outside of the spine of the tibia to the ankle-joint, and thence in a straight line on the dorsum of the foot to the space between the great and the second toe. Two transverse incisions should be made; an upper one extending from the ligamentum patellæ to the outer hamstring, and a lower one from one malleolus to the other in front of the ankle-joint. If the thigh and back part of the leg have already been dissected, it may not be necessary to make any new incisions, or it may be more convenient to make them in a different manner; the student will have no difficulty in determining the most convenient way, when he remembers that the manner in which the skin is removed has nothing to do with the dissection of the parts beneath it, except to get it out of the way as fast as, but no faster than is required to expose those parts, and to use it for covering them when he is not dissecting. Care is necessary here as well as elsewhere in

removing it not to take up the superficial fascia with it, if the subcutaneous vessels and nerves are to be examined.

Having raised the integument on the leg as far as the inner angle of the tibia internally, and to a short distance behind the fibula externally, and on the foot as far as its inner and outer borders back to within about an inch of the heel, the *vessels* and *nerves* in the superficial fascia should be dissected. There is neither any subcutaneous artery or vein of sufficient size on the anterior or outer part of the leg, to require any special notice. The only nerve of much importance is the *musculo-cutaneous*, Fig. 242 (3), a branch of the external popliteal or peroneal nerve. This nerve must be looked for perforating the deep fascia near the junction of the middle with the lower third of the leg, and a little to the inner side of a line corresponding to the fibula. It is quite a large nerve, and with a little care the student cannot fail to find it; and when found, it is easily traced down the leg, and on the dorsum of the foot. It gives off a small branch called the *external malleolar branch*, which passes over the external malleolus, and anastomoses with a branch of the external saphenous nerve. It then divides into four *terminal branches*, which are distributed to the toes. The *first* one, commencing internally, goes to the inner side of the great toe; the *second* goes to the outer side of the great toe, and to the inner side of the second toe; the *third* supplies the outer part of the second, and the inner part of the third toe; the *fourth* is distributed to the outer side of the third, and to the inner side of the fourth toe. The last-named branch anastomoses with the external saphenous, which not unfrequently supplies

Fig. 242.



PLAN OF THE CUTANEOUS NERVES ON THE FOREPART OF THE LEG, AND THE DORSUM OF THE FOOT.—1. Internal or long saphenous, become subcutaneous. 2, 2, 2. Branches of the external popliteal. 3. Musculo-cutaneous. 4. Anterior tibial.

this branch, instead of the musculo-cutaneous. The branch that supplies the inner part of the great toe anastomoses with the internal saphenous nerve. The other branches anastomose with the anterior tibial nerve; sometimes they are wanting, when their places are supplied by branches of the anterior tibial. The branches of the musculo-cutaneous not only supply the toes to which they are distributed, but also the integument on the lower and forepart of the leg, and on the middle part of the dorsum of the foot. The integument on the inner part of the leg is supplied by branches of the internal saphenous, Fig. 242 (1), while the external popliteal, or the peroneal cutaneous, Fig. 242 (2, 2, 2), supply the integument on the outer part of the leg.

Fig. 243.

After removing the skin from the dorsum of the foot, besides the nerves just noticed the superficial *veins*, Fig. 243, should be examined. These consist of an *internal* and an *external dorsal vein*, which are connected across the metatarsus so as to form an arch called the *dorsal arch.* The veins of the toes empty into this arch; and, also, branches from the internal and external plantar veins. The saphenous veins have their origin in this arch, or rather in the internal and external dorsal veins. There are other veins on the dorsum of the foot and on the anterior part of the leg, but they require no special notice; they terminate either in the internal or external saphenous vein. The superficial fascia

The Superficial Veins of the Front of the Right Leg.—1. Internal or long saphenous above the leg. 2. The same vein on the inner side of the leg. 3. A transverse branch below the knee which receives all the venous branches from the front of the leg. 4. A branch which anastomoses with the deep-seated veins. 5. The dorsal vein on the inner side of the foot. 6. The arch formed by the inner and outer dorsal veins.

may now be dissected off to expose the *deep fascia*, and the *external* and *anterior annular ligaments.*

The *deep fascia* on the *anterior part* of the leg is thicker and stronger than on any other part. It is composed in the upper part of fibres which have an oblique direction, and interlace with each other; in the lower part they are circular. It is continuous *above* with the fascia lata as it is continued downwards in front of the knee-joint, and is also attached to the tubercle of the tibia; *internally*, it is attached to the spine of the tibia; *externally*, to the fibula; and *below*, to the anterior annular ligament. Thus, it will be seen that it forms a sheath for the muscles on the anterior part of the leg; besides forming a sheath common to the muscles, it sends processes or intermuscular septa in between them, especially in the upper part of the leg. The tibialis anticus and the extensor longus digitorum communis have, as will be seen, their origin in part from these intermuscular septa; they also arise partly from the inner surface of the fascia, where it covers them.

The *deep fascia* on the *outer side* of the leg is continuous *above*, with the fascia lata, and is attached to the head of the fibula; *laterally*, it is attached to the tibia and fibula, where it assists the anterior and posterior fasciæ in forming two intermuscular septa. This fascia forms a sheath for the long and short peroneal muscles, and sends a process in between them from which, as well as from the inner surface of the sheath, they, in part, have their origin; *below*, it terminates in the external annular ligament.

The *anterior annular ligament*, Fig. 244 (12), consists of a broad fibrous band extending superficially from the internal malleolus and os naviculare obliquely across in front of the ankle-joint to the external malleolus and os calcis. As the deep fascia gradually increases in thickness as it approaches the ligament, it is impossible to fix any distinct line of separation between them. It forms on the inner side next to the tibia a sheath for the tendon of the tibialis anticus, and another for the tendons of the extensor longus digitorum communis and peroneus tertius, which is placed lower down and close to the fibula. The tendon of the extensor longus pollicis also passes through a sheath, which is, however, imperfectly formed; the anterior tibial vessels and nerve pass through the same sheath occupied by the tendon of the extensor longus pollicis. A fibrous band extends from the annular

ligament over the dorsum of the tarsus, and supplies the tendons of the same muscles with sheaths, binding them down at the same time to the tarsus, so that each is kept in its proper position. This layer of fibrous structure is continuous laterally with the plantar fascia. The sheaths of these tendons are lined by synovial membrane, which is also reflected around the tendons themselves.

The *external annular ligament*, Fig. 244 (13), extends from the external malleolus to the outer surface of the os calcis. It forms a sheath for each of the peronei muscles, which pass round the external malleolus. These sheaths, like the preceding, are lined by synovial membrane. The annular ligaments around the ankle-joint are extremely interesting, when viewed as a part of the mechanism of the ankle and foot. Without a knowledge of them it will be impossible for the student to understand properly the actions of the muscles, the tendons of which have a direction quite different from that of those portions in which their contractile power lies.

There are four muscles on the anterior part of the leg, which should now be exposed. To do this the deep fascia may be divided by making a vertical incision, commencing about three or four inches below the knee and about three-fourths of an inch from the spine of the tibia, and extending it down to the annular ligament, which should be preserved for the present. The fascia should then be dissected laterally from the muscles beneath it, so that its attachments to the tibia and the fibula may be observed. Having done this, the muscles should be separated from each other, which should be done at first in the lower part of the leg where they are free. When the tibialis anticus is separated from the extensor longus digitorum communis below, the separation can be extended upwards to their origin by dividing that portion of the fascia, from the under surface of which they partly arise. The fascia cannot be dissected from the upper part of either of the above-mentioned muscles without mutilating them, and leaving a rough surface formed by the cut ends of the fibres. The fascia is here really a part of the muscle, being a part of its tendon of origin in an aponeurotic form.

The Tibialis Anticus, Fig. 244 (3), is placed next to the tibia, occupying the inner part of the anterior interosseous fossa. It *arises* from the head of the fibula, from the inner

part of the interosseous ligament, from the head and the outer surface of the upper two-thirds of the tibia, and from the deep fascia. The fibres pass obliquely downwards and inwards to end at the lower part of the leg in a flattish round tendon, which passes down in front of the lower part of the tibia and the ankle-joint to get to the inner side of the tarsus, to be *inserted* into the tuberosity of the internal cuneiform bone, and by a tendinous fasciculus into the base of the metatarsal bone of the great toe. The fibres join the tendon much lower down behind than before, so that in front the tendon is seen as high as the junction of the middle and lower thirds of the leg; it extends considerably higher, but is concealed by the fibres of the muscle. It passes through a separate sheath formed by the anterior annular ligament, and is surrounded in the sheath by synovial membrane. Its action is to flex the foot upon the leg, to raise the inner part of the foot, and also to adduct it. As a flexor it antagonizes the tibialis posticus, so that when the student has learned its action as such, he has merely to reverse it to understand the action of the posticus.

The Extensor Longus Digitorum Pedis, Fig. 244 (4), is situated in the outer part of the interosseous fossa, having nearly the same relation to the fibula that the preceding muscle has to the tibia. The lower part of it is separated from the fibula by the pero-

Fig. 244.

The Muscles of the Anterior Tibial Region and Dorsum of the Foot.—1. The extensor muscles inserted into the patella. 2. The subcutaneous surface of the tibia. 3. The tibialis anticus. 4. The extensor longus digitorum. 5. The extensor proprius pollicis. 6. The peroneus tertius. 7. The peroneus longus. 8. The peroneus brevis. 9, 9. The borders of the soleus muscle. 10. A part of the inner belly of the gastrocnemius. 11. The extensor brevis digitorum; the tendon in front of this number is that of the peroneus tertius, and those behind it, the tendons of the peronei brevis and longus. 12. Anterior annular ligament. 13. External annular ligament. 14. Ligamentum patellæ.

neus tertius, which on the leg appears to be a part of this muscle. It *arises* from the outer part of the head of the tibia, from the whole of the inner surface of the upper half of the fibula including the head, from the interosseous ligament, and from the intermuscular septum on each side, and the deep fascia of the leg in front. The fibres from these different origins pass downwards, some obliquely and others vertically, to end in a tendon near the junction of the middle and lower thirds of the leg. This tendon immediately divides into three others, which pass through a single canal under the annular ligament, and then continue forwards on the dorsum of the tarsus, the external one dividing into two to reach the outer four toes, into the last two phalanges of which they are *inserted.* If the upper part of this muscle be detached from the fascia which covers it and the intermuscular septa on its sides, the surfaces thus formed will be very rough. On the dorsum of the foot, the four tendons cross over at an acute angle, from within outwards, the tendons of the short extensor of the toes; each tendon spreads out on the dorsum of the first phalangeal bone, which it passes over to divide at the articulation of this bone with the second, into three parts, the middle one of which is inserted into the base of the second phalangeal bone, while the other two pass forwards, to be inserted in common into the base of the last phalangeal bone. The action of this muscle is to extend the toes with which it is connected, and to flex the foot on the leg; it may also assist the tibialis anticus in inverting the sole of the foot.

The Peroneus Tertius, Fig. 244 (6), is placed to the outer side of the preceding muscle, of which it not unfrequently seems to be a part. It *arises* from the anterior and inner part of the lower half of the fibula, soon forms a tendon which passes downwards through the same canal under the annular ligament as the extensor longus digitorum; it then descends obliquely outwards over the tarsus to reach the base of the fifth metatarsal bone, into which it is *inserted.* A tendinous band sometimes connects the tendon of this muscle with the outer tendon of the preceding muscle. Its principal action is to elevate the outer border of the foot; in this way it may antagonize the action of the long extensor muscles of the toes, as far as those muscles may tend

to invert the sole of the foot; it may also assist in extending the fifth toe, or in flexing the foot on the leg.

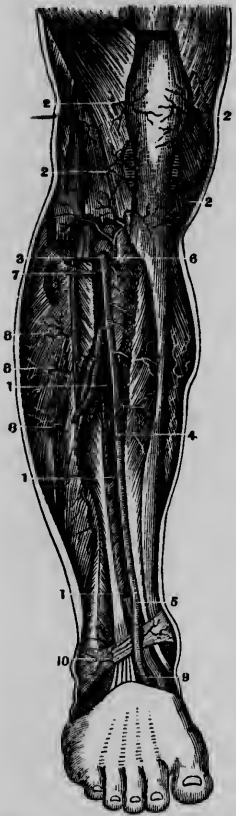
The EXTENSOR POLLICIS PROPRIUS, Fig. 244 (5), is placed between the tibialis anticus on the inner side, and the extensor longus digitorum on the outer side; the upper part of it is covered by these muscles. It *arises* from the inner surface of the fibula, commencing usually as high as the junction of the upper and middle thirds, and from the interosseous ligament close to the fibula; it may also be joined by a few fibres which arise from the lower part of the tibia. The fibres terminate in a tendon which, commencing higher in front than behind, passes first under the annular ligament, then forwards over the tarsus and the metatarsal bone of the great toe, to be *inserted* by two fasciculi into the base of the first phalangeal bone, and by one fasciculus into the base of the second phalangeal bone. Its relations to the anterior tibial artery are interesting, and will be noticed in the description of that vessel. Its action is to extend the great toe, and to flex the foot on the leg; it may also assist in raising the inner border of the foot.

The EXTENSOR BREVIS DIGITORUM, Fig. 244 (11), is placed on the dorsum of the foot, being the only muscle in that region, except the interossei, that has its origin and insertion on the foot. It *arises* on the outer part of the foot from the os calcis and astragalus by a short round tendon and some muscular fibres. It passes obliquely forwards and inwards beneath the tendons of the extensor longus digitorum and peroneus tertius to divide into four tendons, which are continued forwards to be *inserted* into the phalangeal bones of the inner four toes, the little toe having no tendon from this muscle. The one to the great toe is larger than either of the others; it passes over the dorsal artery of the foot just before it enters the first interosseous space, and under the tendon of the long extensor of the great toe, and is *inserted* into the base of the last phalangeal bone of the great toe. The other tendons get beneath the corresponding tendons of the long extensor of the toes, and become blended with them in forming the fibrous sheaths which cover the dorsa of all the smaller toes. The action of this muscle is to extend the toes. Its direction being obliquely from without inwards it counteracts the tendency of the long extensors to draw the toes towards the

inner side of the leg, so that by their combined action the toes will be extended in a line directly backwards.

Having now examined the muscles on the anterior part of the leg and dorsum of the foot, the deep vessels and nerves found in this region should next be noticed. To do this it will not, however, be necessary to raise the muscles, for they can be pushed sufficiently to one side or the other to get to the vessels or nerves. The anterior tibial artery and veins, with their branches, are the only vessels; the anterior tibial and the muscular cutaneous, for a short distance, are the only nerves.

Fig. 245.



A VIEW OF THE ANTERIOR TIBIAL ARTERY AND ITS BRANCHES.—1, 1, 1. The remains of the extensor proprius pollicis pedis muscle and tendon. 2, 2, 2, 2. Superficial branches from the popliteal artery, known as articular arteries. 3. Anterior tibial artery, as it comes through the interosseous ligament. 4. The same artery, on the middle of the leg. 5. Point where it passes under the extensor proprius tendon above the annular ligament. 6. Anterior recurrent branch. 7. Branch to the extensor communis, soleus, and peroneus longus muscles. 8, 8, 8. Other muscular branches. 9. Arteria dorsalis pedis, or continuation of the anterior tibial on the foot. 10. A branch of the external malleolar artery.

The ANTERIOR TIBIAL ARTERY, Fig. 245 (3, 4, 5), is one of the divisions of the popliteal artery. It passes immediately through an opening in the upper part of the interosseous ligament, to get into the anterior interosseous fossa or space, in which, resting on the anterior surface of the interosseous ligament, it passes downwards to the ankle-joint, where it terminates in the dorsal artery of the foot. It is placed, in the upper third of its course, between the tibialis anticus and the extensor longus digitorum; below this, down to about the middle of the lower third, it is found between the last-named muscle and the extensor pollicis proprius, while in the remainder of its course it is placed, at first, behind the tendon of the extensor poll-

icis, and then between it and the extensor longus digitorum.

Thus, it will be seen that the extensor pollicis is placed at first to the outer side, then in front, and lastly to the inner side of this artery, which, in the upper third of the leg, can have no relation to this muscle whose origin begins at the junction of the upper and middle thirds. The student should notice the distance of this artery from the skin, as it descends to the ankle, or the depth of an incision that would reach it in any part of its course; he should also observe how far from the spine of the tibia, and in what direction an incision should be made, for the purpose of ligating it in the living subject. Besides muscular branches which are not named, the anterior tibial artery gives off the *anterior tibial recurrent*, and an *external* and an *internal malleolar branch.*

The *anterior tibial recurrent branch*, Fig. 245 (6), arises from the anterior tibial artery as soon as it has reached the anterior interosseous space. It passes upwards and inwards on the surface of the inner tuberosity of the head of the tibia, covered by the origin of the tibialis anticus; it then divides into branches, which anastomose with the inferior external and internal articular branches of the popliteal artery.

The *internal malleolar branch*, Fig. 246 (10), arises just above the anterior annular ligament, passes inwards and downwards beneath the tibialis anticus, and divides into two branches, one of which enters the ankle-joint, while the other passes over the surface of the internal malleolus, below which, on the inner side of the foot, it anastomoses with branches of the internal plantar artery.

The *external malleolar branch*, Fig. 246 (11), usually arises near the anterior annular ligament; it varies, however, very much in its origin and distribution, and also in its size. It is distributed on the outer part of the foot, anastomosing with branches of the peroneal artery externally and with branches of the dorsal artery of the tarsus inferiorly; it usually gives off quite a large branch to the articulation of the ankle.

The *dorsal artery of the foot*, Fig. 246 (7, 9), commences at the anterior annular ligament, being a continuation of the anterior tibial, and extends forwards on the tarsus to the first interosseous space, into which it dips to join the external plan-

Fig. 246.

THE SUPERFICIAL ARTERIES ON THE TOP OF THE FOOT.—1. Tibialis anticus muscle. 2. Extensor proprius pollicis pedis. 3. Extensor communis tendon, cut off. 4. Extensor brevis digitorum pedis. 5. Anterior tibial artery, between the extensor tendons. 6. Some of its muscular branches. 7. Opposite to commencement of dorsal artery. 8. Opposite to dorsal artery of the foot. 9. Point where it dips to anastomose with the external plantar. 10, 11. Two malleolar arteries. 12, 13. Muscular branches of the dorsal artery of the foot. 14. Metatarsal artery. 15, 16, 17. Its interosseal branches and their distribution.

Fig. 247.

THE DEEP-SEATED ARTERIES ON THE TOP OF THE FOOT.—1. Point where the anterior tibial reaches the foot. 2. Dorsal artery of the foot. 3. Point where it dips to join the plantar arch. 4. Internal malleolar artery. 5. Dorsal artery of the tarsus. 6. A branch to the extensor brevis muscle. 7. Branches of the dorsal artery. 8. Branches to the ligaments. 9. Metatarsal artery. 10. Superior branches of the metatarsal artery. 11. Interosseous arteries. 12. Posterior perforating branches of the metatarsal. 13. Plantar interosseous arteries, seen through the interosseous spaces. 14. Anterior perforating branches of the metatarsal. 15. Bifurcation of the interosseous to give the digital of the toes. 16. Dorsalis pollicis. 17. A digital branch to the inside of the great toe. 18. Bifurcation of the dorsalis pollicis. 19. Its perforating branch. 20, 21, 22. Distribution of the digitals. 23. Section of the posterior tibial. 24. Branch of the posterior peroneal artery.

tar artery. It lies to the outer side of the tendon of the extensor of the great toe, and is covered by the skin, the superficial and the deep fascia. It gives off several branches; those

which are directed to the inner part of the foot are not named; they vary in number, size, and distribution. They anastomose behind with the internal malleolar branch of the anterior tibial artery, and below with branches of the internal plantar; those which go to the dorsum of the outer part of the foot are the following:—

The *dorsal artery of the tarsus*, Fig. 247 (5), passes outwards beneath the extensor brevis digitorum and divides into several branches, which anastomose with the external malleolar branch of the anterior tibial, with the external plantar artery, and with the one next to be described. It varies in size and in the number of branches which it gives off.

The *metatarsal branch*, Fig. 247 (9), usually arises just before the dorsal artery of the foot disappears in the interosseous space. It passes transversely outwards in a line corresponding nearly to the tarso-metatarsal articulations, forming an arch from which branches are given off to supply the interosseous spaces and the integument on the upper part of the toes. They are called the *interosseous* and *digital arteries*. There is one for each of the interosseous spaces except the first, which is supplied directly from the dorsal artery of the foot. Each interosseous artery divides into two digital branches, which are distributed to the opposing sides of the two toes which correspond to the artery. The relations and distribution of the three interosseous arteries are very nearly similar. They anastomose with branches of the corresponding arteries on the bottom of the foot. Each interosseous artery is joined by an anastomosing branch at each extremity of the interosseous space.

The Deep Veins consist of those which accompany the arteries, each artery having its *venæ comites*. They communicate with the superficial or subcutaneous veins at different points. The venæ comites are generally arranged so as to have one on the outer and one on the inner side of the artery which they accompany; they communicate freely with each other by means of branches extending between them across the artery. The deep veins are supplied with valves.

The Anterior Tibial Nerve, Fig. 248 (2, 3), is one of the terminal divisions of the external popliteal or peroneal, which it leaves between the peroneus longus and the external sur-

face of the fibula just below its head; it then passes beneath the flexor longus digitorum, getting between it and the tibialis anticus, where it joins the anterior tibial artery which it accompanies down the leg to the foot, being placed in front of it. Just before the external popliteal nerve divides into the musculo-cutaneous and the anterior tibial it gives off a small branch to the tibialis anticus muscle, and another to the tibio-fibular articulation. Below the anterior annular ligament the anterior tibial nerve divides into two branches; one of which accompanies the dorsal artery to the first interosseous space, where it divides into two branches which are distributed, one to the two sides of the great toe, and the other to the inner side of the second toe. These last branches either anastomose with or take the place of the corresponding branches of the musculo-cutaneous nerve. The other terminal division of the anterior tibial passes obliquely outwards beneath the short common extensor of the toes, and divides into several branches, some of which go to that muscle, while others are distributed to the interosseous spaces.

Fig. 248.

A VIEW OF THE MUSCULO-CUTANEOUS AND THE ANTERIOR TIBIAL NERVE.—1. The musculo-cutaneous nerve. 2, 3. The anterior tibial nerve accompanying the artery of the same name.

The *Musculo-Cutaneous Nerve*, Fig. 248 (1), will be seen in the dissection of the muscles on the anterior part of the leg, only while passing between the peroneus longus and the flexor longus digitorum muscles; below this it perforates the deep fascia and becomes subcutaneous, which part of it has already been described in the superficial fascia. In the first part of its course it passes through the substance of the peroneus longus, and must be examined when that muscle is dissected.

On the outer part of the leg will be found the peronei

muscles, long and short. They cover the whole of the external surface of the fibula except about two inches and a half at the lower end, where the bone is subcutaneous, and can be distinctly felt beneath the skin. When compared with the tibia, the fibula will be seen to have but little subcutaneous surface; it gives origin or attachment to muscles on every side, while but two of the three sides of the tibia are thus occupied. The fibula belongs essentially to the foot, the tibia to both the thigh and foot, perhaps more, however, to the former than to the latter. Only one muscle passes over the knee-joint to be attached to the fibula, while nine will be found passing over it to be attached to the tibia; the reverse is true to some extent of the attachments of those muscles to the tibia and fibula which pass over the ankle-joint to the foot.

The *musculo-cutaneous nerve*, Fig. 248 (1), one of the terminal divisions of the external popliteal, should now be sought in the substance of the peroneus longus, in order that it may be traced through this muscle to the space between it and the extensor longus digitorum. This nerve was noticed in the dissection of the superficial fascia and muscles on the anterior part of the leg, and on the dorsum of the foot; it only remains now to examine it in its course through the peroneus longus, and the branches which it gives off to the peronei muscles.

The PERONEUS LONGUS, Fig. 244 (7), *arises* from the anterior and outer surface of the head of the fibula, from a small portion of the external surface of the head of the tibia, from the outer surface of the upper half of the fibula below the head, from the intermuscular septum on each side of it, and from the fascia which covers it. From these different points of origin the fibres pass downwards to end in a ribbon-shaped tendon near the middle of the leg, where it is closely applied to the peroneus brevis; becoming narrower, the tendon descends to the groove behind the external malleolus, where it passes under the external annular ligament in a canal with the short peroneus; it then turns forwards to a groove on the outer border of the cuboid bone, through which it passes to enter the sole of the foot; from this point it is directed obliquely forwards and inwards to the base of the metatarsal bone of the great toe, into which it is *inserted*, Fig. 266 (8). It is covered by ligamentous fibres at the outer border of the cuboid bone, and also in the sole of the foot; these fibres

form a sheath for it at each place, lined by a synovial membrane; the canal through which it passes behind the external malleolus is also lined by a synovial membrane. It will be seen that the tendon of this muscle passes over two trochlear surfaces, one behind the malleolus from which it is reflected forwards and downwards, the other at the outer border of the cuboid bone where it is reflected forwards and inwards. A sesamoid bone is frequently found in the tendon where it passes over the cuboid bone. The action of this muscle is to extend the foot on the leg and to depress the inner border of the foot, elevating at the same time the outer border. The examination of the tendon of this muscle in the sole of the foot must be postponed until the parts which cover it there have been dissected.

The PERONEUS BREVIS, Fig. 244 (8), *arises* from the external surface of the lower half of the fibula, and from the intermuscular septum on each side of it; its tendon commencing a short distance above the external malleolus, but lower than that of the peroneus longus, descends to the groove behind the malleolus where it passes through the same canal as the preceding muscle; it is then continued forwards and downwards through a groove on the outer side of the os calcis to the base of the metatarsal bone of the little toe, into which it is *inserted;* sometimes it is connected by a few fibres to the cuboid bone or to the base of the fourth metatarsal bone, or it may send a slip to the extensor tendon of the little toe. On the outer side of the fibula and behind the external malleolus it is placed beneath the peroneus longus, but is above it on the outer side of the os calcis, where it is surrounded by a synovial membrane. Its action is the same as that of the peroneus longus. These muscles should be examined with reference to fracture of the fibula, and, also, to displacement of their tendons, by being forced out of the canal through which they pass, behind the external malleolus.

SECT. VI.—DISSECTION OF THE SOLE OF THE FOOT.

The anatomy of the sole of the foot demands the careful attention of the student. Its arteries and nerves, from their

exposed situation, are constantly liable to injury, especially among the poorer classes of people, who are in the habit of dispensing with the use of shoes or boots. Punctured wounds are frequently met with in the sole of the foot, which are liable to be followed by tetanus, or by collections of pus; in either case, the proper treatment must be based mainly on the anatomy of the parts. The same is true in the case of incised wounds, in which hemorrhage occurs, requiring the employment of prompt and efficient means for arresting it. Deformities are also met with, in the treatment of which a thorough knowledge of the foot is demanded. And the same may be said in regard to injuries of various kinds, requiring surgical treatment. The question, as to the removal of a part or the whole of the foot by excision or amputation, must frequently be decided by the extent of injury which the parts have sustained; and, to be able to determine this, the surgeon must have an accurate knowledge of all the parts involved. In the management of such cases, the surgeon cannot rely on any rules which he may have learned in the lecture-room or in books; for it is impossible to lay down any set of rules which will meet the indications of every case that may occur. Whether the patient shall lose the whole or a part of his foot, or shall have the limb saved entire, may depend wholly upon a slight variation in the extent of the injury inflicted, and which can be detected only by the surgeon having a distinct idea of all the parts, and their relations to each other, which enter into the structure of the foot.

To dissect the sole of the foot, a block must be placed under the instep, so that the foot can be fully extended on the leg, with the plantar surface looking upwards; it must also be firmly fixed in this position; if this be neglected, the dissector will be constantly annoyed by the foot moving about, its own weight being insufficient to assist much in keeping it in the position required, and the integument is so closely connected to the aponeurosis or fascia beneath it, by numerous fibres prolonged from its under surface and from the subcutaneous adipose substance into the aponeurosis, that considerable force is required to divide them in raising the skin. To be able to make this dissection properly, the student must be provided with sharp scalpels, otherwise he will almost necessarily, either remove portions of the aponeurosis with the skin, or leave

more or less of the adipose substance attached to the aponeurosis.

The Plantar Aponeurosis or Fascia covers nearly the whole of the under surface of the foot. It presents a pearly white, shining appearance, which will enable the dissector to distinguish it from the integument, and hence to know when he has reached it in making the first incision through the skin, or when, during the progress of the dissection, he is leaving nothing but the aponeurosis. It is divided into a *middle*, an *external*, and an *internal portion*; the separation of these is indicated by two shallow grooves or sulci, caused, as will be seen, by the arrangement of the muscles which they cover.

The *middle portion* is thicker than either of the others. It arises from the posterior inner tubercle on the under surface of the os calcis, and extends to the metatarso-phalangeal articulation, where it divides into four parts. It increases in breadth from behind forwards, without, however, diminishing much in thickness. Laterally, its borders project upwards between the muscles which it covers and those covered by the internal and external portions, with which it unites to form two intermuscular septa; these are more perfect before than behind. Each of the processes, into which it divides anteriorly, subdivides into two others, which are placed, one on each side of the corresponding metatarso-phalangeal articulation, so as to include between them the sheath and the tendons, one of the short and the other of the long common flexor of the toes, which pass through it; they terminate by becoming attached to the sheath, and to the ligaments of the joint. Laterally, the processes are united to each other so as to form arches which correspond to the anterior extremities of the interosseous spaces, and beneath which the digital arteries and nerves, also the lumbricales and the interosseous muscles, pass to reach the toes. For some distance from its posterior attachment, its upper or deep surface is occupied by the origin of a portion of the fibres of the flexor brevis digitorum; this fact the student must bear in mind when he comes to raise this portion of the aponeurosis; to do which, it should be carefully divided transversely, about an inch and a half from its origin, where it begins to be separated from the muscle by areolar tissue; the portion behind this point

cannot be raised except by detaching it from the fibres of the muscle; hence it may be left to be raised with the muscle.

The middle portion of the aponeurosis forms a common sheath for the flexor brevis digitorum, flexor longus digitorum, flexor longus pollicis, musculus accessorius, the lumbricales, and the plantar vessels and nerves. Being attached to the posterior extremity of the tarsus, and anterior extremity of the metatarsus, it greatly strengthens the arch of the foot in an antero-posterior direction, and also in an opposite direction by some transverse fibres found in the part immediately below the metatarsus. It not only contributes to the strength of the framework of the foot, and serves to keep the muscles, for which it forms a sheath, *in situ*, but it protects the parts above it.

The *internal portion* is thinner than the external, being so thin anteriorly that considerable care is requisite to preserve it when the integument is removed. Posteriorly, it is connected to the internal annular ligament, or the ligamentous arch that extends from the os calcis to the internal malleolus; internally, it is partly attached to the inner border of the tarsus, and partly continuous with the dorsal fascia; externally, it is joined to the middle portion, and assists in forming the internal intermuscular septum. It forms a sheath, in part, for the muscles of the great toe, and the plantar vessels and nerves. Besides protecting the parts beneath it, it strengthens the inner part of the foot.

The *external portion* arises behind, from the external annular ligament, or the ligamentous arch that extends from the external malleolus to the os calcis; it is attached to the outer border of the tarsus, where it is also continuous with the dorsal fascia. It forms, by its attachment to the cuboid bone and the posterior extremity of the fifth metatarsal bone, a strong ligamentous arch over the tendon of the peroneus longus where it enters the sole of the foot; internally it is connected to the external intermuscular septum, and to the middle portion of the aponeurosis. It covers the abductor and flexor brevis minimi digiti muscles. Its uses are similar to those of the inner portion.

Having now exposed and studied the plantar aponeurosis, it must be raised in order to examine the parts placed above it. From what has already been said in describing the plantar aponeurosis and the long flexor muscles, together with

the posterior tibial nerve and vessels on the back of the leg, the student has obtained some idea of what he will find above the aponeurosis. Two of the superficial muscles may be examined first, as this can be done not only without injuring the vessels and nerves, but it will facilitate the dissection of them; of these, the following muscle may be first examined, as it occupies the central part of the sole of the foot, and sustains more important relations to the vessels and nerves than any other in this region. It separates the grooves in which the external and internal plantar arteries are found.

The FLEXOR BREVIS DIGITORUM PERFORATUS, Fig. 249 (5), *arises* from the under surface of the posterior and inner part of the os calcis, from the intermuscular septum on each side of it, from the plantar fascia which covers its under surface, and also from the internal annular ligament. From these different points of origin it passes forwards to near the middle of the foot, where it divides into four small muscles, each of which proceeds forwards a short distance and terminates in a small tendon, which is continued to the base of the second phalangeal bone, where it divides into two slips, between which the corresponding tendon of the long common flexor of the toes passes; the slips unite again, and, after expanding laterally, are *inserted* into the under surface of the second phalangeal bone. It corresponds, in the division of its tendon, to the superficial common flexor of the forearm. It is quite thick at its origin, where it is both fleshy and tendinous, but increases in breadth towards the middle of the foot. Its action is to flex the four outer toes; it may also strengthen the middle aponeurosis in preserving the arch of the foot. To expose this muscle, a transverse incision may be made across the middle portion of the aponeurosis, as was before mentioned, about an inch or an inch and a half anterior to its origin, taking care not to divide anything but the aponeurosis. The portion in front of the incision may next be raised. To do this, it may be dissected from behind forwards, detaching it from the intermuscular septum on each side; or it may be divided longitudinally into four portions, so that each shall correspond to one of the four processes into which the aponeurosis divides anteriorly, and then dissect each portion to its subdivision into its two slips, and their attachments to the sheath of the tendons of the short and long common

flexors of the toes. In doing this, unless the dissection is very carefully made, one or more of the small delicate tendons of the short common flexor will be destroyed. This is very apt to occur in the first dissection which the student makes of these parts. The aponeurosis, behind the first incision that was made, can easily be separated on the sides, but not on the under surface of the muscle. There is no necessity, however, for raising this part of it, as it can be raised with the muscle. To raise the muscle it may be detached from the bone and reflected forwards, or it may be divided near its centre and turned, part of it backwards and part of it forwards. The abductor pollicis may next be exposed. The internal aponeurosis should be removed by dissecting it off in the direction of the fibres of the abductor muscle.

The Abductor Pollicis, Fig. 249 (3), *arises* from the os calcis, from the internal annular ligament, from the plantar aponeurosis, and from the intermuscular septum between it and the flexor brevis digitorum. It passes forwards to end in a tendon which is *inserted*, in common with the internal division of the flexor brevis, into the base of the first phalangeal bone of the great toe. Its action, as its name implies, is to separate the great toe from the others; it may also assist in flexing the great toe. This muscle may now be turned over, but in doing so some care is necessary to avoid injuring the plantar vessels and nerves which pass under that portion of it which arises from the os calcis and the annular ligament. They can be easily preserved and traced beneath the origin of this muscle, if the vessels and nerves on the

Fig. 249.

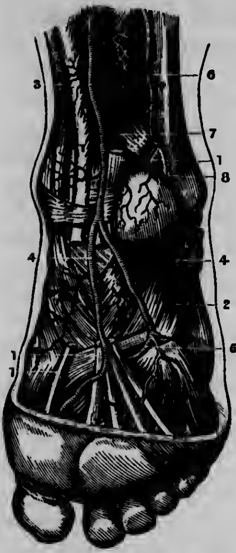
The First Layer of Muscles in the Sole of the Foot; this layer is exposed by the removal of the Plantar Fascia.—1. The os calcis. 2. The posterior part of the plantar fascia divided transversely. 3. The abductor pollicis. 4. The abductor minimi digiti. 5. The flexor brevis digitorum. 6. The tendon of the flexor longus pollicis muscle. 7, 7. The lumbricales. On the second and third toes, the tendons of the flexor longus digitorum are seen passing through the bifurcation of the tendons of the flexor brevis digitorum.

back of the leg have not been destroyed. The posterior tibial artery has been seen to bifurcate at a point about midway between the internal malleolus and the os calcis. From this bifurcation the external and internal plantar arteries pass forwards and outwards to enter the sole of the foot.

The *internal plantar artery*, Fig. 250 (4), gets into the sulcus between the abductor pollicis and flexor brevis digitorum muscles, and passes forwards to the anterior part of the first interosseous space, where it usually terminates by sending one, and sometimes two branches, to the great toe. In its course it gives off branches to the muscles, to the integument, and to anastomose with branches of the dorsal artery of the foot.

The *external plantar artery*, Fig. 251 (5, 6), when it has reached the sole of the foot, turns outwards and forwards beneath the flexor brevis digitorum, and thus gets into the sulcus between the flexor brevis digitorum and the abductor minimi digiti, in which it continues for a short distance, then turns inwards across the second and third metatarsal bones and interosseous spaces, to reach the first interosseous space, where it anastomoses with the dorsal artery of the foot. The anterior curved portion of it is called the *plantar arch*. At first, it passes, as has already been seen, under the abductor pollicis, then through the posterior part of the internal groove where it can be reached without dividing any muscle; it then passes under the flexor brevis digitorum and enters the external groove where it can again be reached without cutting through any muscle; as it leaves the groove it becomes deep-seated, getting between the tendons and the common flexor muscles of the toes and the interosseous muscles; so that in its course it is in three places situated beneath muscles, and in two places subaponeurotic. In the first and the middle part of its course, it gives branches to the *integument* on the heel, to *muscles*, and to the *tarsal articulations*, also to *anastomose* with the tarsal and metatarsal branches of the dorsal artery of the foot. Two sets of branches are given off from the arch. The *posterior perforating branches*, three in number, pass upwards through the second, third, and fourth interosseous spaces, and anastomose with the corresponding interosseous arteries on the dorsum of the foot. The *anterior* or *digital arteries*, Fig. 251 (14), four or five in number, pass forwards to supply the toes; at the anterior extremities of the inter-

Fig. 250.



A VIEW OF THE ARTERIES ON THE BACK OF THE RIGHT LEG AND THEIR CONTINUATION ON TO THE SOLE OF THE FOOT.—1, 1, 1, 1. Tendons of the flexor communis and flexor longus pollicis pedis. 2. Tendon of the peroneus longus. 3. Posterior tibial artery at the ankle. 4, 4. External and internal plantar arteries. 5. Points where the external plantar dips to form the plantar arch. 6. Peroneal artery, just above the origin of the external malleolar branch. 7. A branch to anastomose with the posterior tibial. 8. Just above the division of the peroneal artery into its anterior and posterior branches.

Fig. 251.

THE DEEP-SEATED BRANCHES OF THE ARTERIES ON THE SOLE OF THE FOOT.—1. Posterior tibial artery by the side of the astragalus. 2. Branches to the os calcis. 3. Branch of the posterior peroneal artery. 4. Bifurcation of the posterior tibial into the internal and external plantar. 5. The external plantar artery. 6. Point where it forms the plantar arch. 7. Anastomosis of the anterior tibial with the plantar arch. 8, 9, 10. Muscular branches of the external plantar artery. 11. Anastomosis of this artery with the metatarsal. 12, 13. External digital of the little toe. 14. Digital arteries of the other toes. 15, 15, 15, 15. Their distribution on the toes. 16. Origin of the internal plantar artery. 17. Its anastomosis with the plantar arch. 18, 19, 20. Muscular branches of the internal plantar artery. 21. Digital of the great toe, or arteria magna pollicis, as formed by the anastomosis of the internal plantar and plantar arch. 22. Subarticular branch of the great toe. 23. Anastomosis in the pulp of the toe.

osseous spaces, each artery gives off an *anterior perforating branch* which passes upwards through an interosseous space, and anastomoses with a corresponding interosseous branch.

The digital branches then divide, each into an *internal* and *external collateral branch* to go to the toes; these pass forwards on the opposing sides of contiguous toes. There is but one that goes to the outer part of the little toe. The *arteria magna pollicis* arises near the anastomosis of the plantar arch with the dorsal artery, and supplies the outer side of the great toe, and the inner side of the second toe.

Fig. 252.

A VIEW OF THE TERMINATION OF THE POSTERIOR TIBIAL NERVE IN THE SOLE OF THE FOOT.—1. Inner side of the foot. 2. Outer side of the foot. 3. The heel. 4. Internal plantar nerve. 5. External plantar nerve. 6. Branch to the flexor brevis muscle. 7. Branch to the outside of the little toe. 8. Branch to the space between the fourth and fifth toes. 9, 9, 9. Digital branches to the remaining spaces. 10. Branch to the internal side of the great toe.

The *veins* accompany the arteries, there being two for each artery. They anastomose with the dorsal veins along the inner and outer borders of the foot. As they leave the sole of the foot they unite to form the posterior tibial vein.

The *nerves* of the sole of the foot are derived from the posterior tibial which divides behind the internal malleolus into the external and internal plantar.

The *internal plantar nerve*, Fig. 252 (4), passes along the inner side of the os calcis and above the abductor pollicis in company with the artery of the same name, and gets into the internal sulcus or groove, in the anterior part of which it divides into four digital branches, which supply the great, the second, the third, and the inner side of the fourth toe. Its distribution to the toes is the same as that of the median nerve is to the fingers. In the anterior part of its course, it perforates the sheath, in which the flexor brevis digitorum is placed, and continues for a short distance along the inner border of that muscle. It gives off several branches to the muscles and to the integument before it divides into its terminal branches. Near its origin, it sends quite a large branch to the integument on the heel.

The *external plantar nerve*, Fig. 252 (5), accompanies the

external plantar artery above the short common flexor, and in the external sulcus as far as the commencement of the plantar arch, where it divides into a *superficial* and a *deep-seated branch.* The superficial branch, which is cutaneous, is distributed to the little toe, supplying both sides of it, and to the outer part of the fourth toe. The deep branch passes inwards and upwards across the metatarsus, forming an arch similar to that formed by the external plantar artery; it is distributed to the deep muscles. Frequently, it sends quite a large branch to anastomose with the internal plantar. It also sends filaments to the articulations of the tarsus and metatarsus.

The FLEXOR BREVIS POLLICIS, Fig. 254 (5), *arises* from an aponeurosis which partly covers it, from the inner margin of the cuboid bone, from the external cuneiform, and from the tendon of the tibialis posticus. It divides into two bellies, which are *inserted* by short tendons into the sides of the base of the first phalangeal bone. A sesamoid bone is generally found in each of its tendons. The tendon of the long flexor of the great toe is placed between its bellies.

The FLEXOR ACCESSORIUS OR MASSA CARNEI JACOBI SYLVII, Fig. 253 (3), *arises* by two heads; one, larger than the other, from the inner side of the os calcis, and the other from the under and anterior surface of the same bone; from these origins, the two heads pass forwards, soon uniting to form a single belly which is *inserted* into the outer, upper, and lower surfaces of the tendon of the flexor longus digitorum just before, or as it divides into its four tendons. Its action is to assist the long flexor in flexing the toes, and to give a direction to the action of that muscle parallel to the axis of the foot. The connection between the tendons of the long common flexor of the toes and the long flexor of the great toe should now be examined, and their tendons dissected.

The LUMBRICALES, Fig. 253 (4, 4), are four small muscles, which *arise* from the four tendons of the long common flexor near its division, and, passing along the inner side of them, each ends in a small flat tendon, which is *inserted* into the inner and dorsal surface of the first phalangeal bone, where it also joins the tendon of the long extensor of the toes. The action of these muscles is to adduct and assist in flexing the toes,

with which they are connected; when the toes are partly extended, they can assist in extending them further. These muscles, together with the tendons of the long flexors, may now be removed.

Fig. 253.

Deep-seated Muscles in the Sole of the Foot.—1. Tendon of the flexor longus pollicis. 2. Tendon of the flexor communis digitorum pedis. 3. Flexor accessorius. 4, 4. Lumbricales. 5. Flexor brevis digitorum. 6. Flexor brevis pollicis pedis. 7. Flexor brevis minimi digiti pedis, including the abductor minimi digiti.

Fig. 254.

The Third and a Part of the Second Layer of Muscles on the Sole of the Foot.—1. The divided edge of the plantar fascia. 2. The flexor accessorius. 3. The tendon of the flexor longus digitorum. 4. The tendon of the flexor longus pollicis. 5. The flexor brevis pollicis. 6. The adductor pollicis. 7. The flexor brevis minimi digiti. 8. The transversus pedis. 9. Interossei muscles, plantar and dorsal. 10. Convex ridge formed by the tendon of the peroneus longus muscle in its oblique course across the foot.

The Adductor Pollicis, Fig. 254 (6), *arises* from the cuboid bone and the long calcaneo-cuboid ligament, from the posterior extremities of the second, third, and fourth metatarsal bones, and from the sheath of the peroneus longus. It passes from these different origins obliquely inwards to be *in-*

serted, in common with the external head of the flexor brevis pollicis, into the outer part of the base of the first phalangeal bone of the great toe. Its action is to draw the great toe outwards towards the other toes; it may also, with the outer division of the flexor brevis pollicis, draw it downwards and outwards under the other toes.

The TRANSVERSALIS PEDIS, Fig. 254 (8), *arises* from the anterior extremities of the metatarsal bones of the four outer toes, passes transversely inwards between the flexor and interosseous muscles, to be *inserted* into the outer sesamoid bone with the adductor pollicis. Its action is to draw the outer toes towards the great toe, and prevent the metatarsal bones from spreading.

The ABDUCTOR MINIMI DIGITI, Fig. 253 (7), *arises* from the external and inferior surface of the os calcis and the aponeurosis, which covers it; it passes forwards along the external border of the foot, and is *inserted* into the outer part of the base of the first phalangeal bone of the fifth toe. Its action is to separate the little toe from the others, and to assist in flexing it.

The FLEXOR BREVIS MINIMI DIGITI, Fig. 256 (3), *arises* from the sheath of the tendon of the peroneus longus muscle, from the cuboid and the fifth metatarsal bone, and, passing forwards and a little outwards, is *inserted* into the base of the first phalangeal bone of the little toe. Its action is to draw the little toe towards the others, and to assist in flexing it.

There are *seven interosseous muscles*, *three* of which are *plantar* or *inferior*, and *four dorsal* or *superior*. They are found in the interosseous spaces, except the plantar, which are placed more or less on the under surfaces of the metatarsal bones. The plantar muscles are called adductors, while the dorsal are spoken of as abductors.

The ADDUCTOR TERTII DIGITI, Fig. 256 (1), *arises* from the inner side of the third metatarsal bone, and is *inserted* into the inner side of the base of the first phalangeal bone of the middle toe. Its tendon is also blended with the tendons of the extensor muscles of the toes.

The ADDUCTOR QUARTI DIGITI, Fig. 256 (2), *arises* from the inner side of the fourth metatarsal bone, and is *inserted*

into the inner side of the base of the first phalangeal bone of the fourth toe, and also into the tendons of the extensor muscles.

The ADDUCTOR MINIMI DIGITI, Fig. 256 (3), *arises* from the inner side of the fifth metatarsal bone, and is *inserted* into the first phalangeal bone of the little toe. This muscle is very frequently inseparably connected with the flexor brevis minimi.

Fig. 255.

DORSAL INTEROSSEI.—1. Abductor internus secundi. 2. Abductor externus secundi. 3. Abductor tertii. 4. Abductor quarti.

Fig. 256.

PLANTAR INTEROSSEI.—1. Adductor tertii. 2. Adductor quarti. 3. Adductor minimi digiti.

The dorsal or superior interosseous muscles are found on the dorsum of the foot. They arise by two heads. They are usually considered *abductor muscles*, the median line of the foot, which corresponds to the axis of the second toe, being taken as the line from which these muscles draw the toes.

The ABDUCTOR INTERNUS SECUNDI DIGITI, Fig. 255 (1), *arises* from the outer side of the first metatarsal bone, and from the inner side of the second, and is *inserted* into the inner

side of the base of the first phalangeal bone of the second toe; like the plantar, it joins the tendons of the extensor muscles. It draws the second to the great toe or from the median line of the foot.

The ABDUCTOR EXTERNUS SECUNDI DIGITI, Fig. 255 (2), *arises* by two heads from the opposite surfaces of the second and third metatarsal bones, and is *inserted* into the outer side of the base of the first phalangeal bone of the second toe. It draws the second toe from the median line of the foot.

The ABDUCTOR DIGITI TERTII, Fig. 255 (3), *arises* from the opposite surfaces of the third and fourth metatarsal bones, and is *inserted* into the outer side of the first phalangeal bone of the third toe. It separates the third toe from the second.

The ABDUCTOR DIGITI QUARTI, Fig. 255 (4), *arises* by two heads from the opposite surfaces of the fourth and fifth metatarsal bones, and is *inserted* into the outer side of the base of the first phalangeal bone of the fourth toe. It draws the fourth from the third toe.

SECT. VII.—DISSECTION OF THE LIGAMENTS OF THE KNEE, ANKLE, AND FOOT.

The KNEE-JOINT is the largest of all the articulations. From its liability to injuries and diseases of different kinds, its study demands the earnest attention of every student. Before commencing the dissection of it, he should, if possible, carefully examine the bones which enter into its formation, or, at least, as far as they enter into the mechanism of the joint; it is better that they should be examined in an articulated skeleton, as the relative position of each prominent point can then be observed and much better appreciated. He should also carefully observe the prominences and depressions around the joint when the limb is flexed, or extended, or placed in any intermediate position, so that he may be able, in case of disease or injury, to detect any deviation in the general contour of the knee from its natural appearance.

Three bones enter directly into the formation of the knee-joint; they are the *femur*, the *patella*, and the *tibia;* the fibula indirectly contributes to the formation of the joint, inasmuch as it gives attachment to the inferior extremities of the ex-

ternal lateral ligaments, thus compensating for the want of greater breadth in the upper extremity of the tibia to meet the corresponding diameter of the femur. There is but one articular surface on the femur, which may be divided into three parts: a *trochlear* surface for the patella, and two *orbicular* surfaces for the glenoid cavities of the tibia; the former is placed in the middle anteriorly, being continuous laterally and posteriorly with the latter, which are placed behind, one on each side of the inter-condyloid notch. The *glenoid* cavities on the tibia are entirely distinct from each other, being separated by a prominence called the spine of the tibia, and two depressions, one behind and the other before the spine; the inter-glenoid space thus formed corresponds to the inter-condyloid notch; by means of this arrangement, the two strongest ligaments in the joint, the crucial ligaments, are thrown into the central part of the articulation, thus presenting a very interesting feature in the mechanism of this joint. The whole of the posterior surface of the patella is covered by articular cartilage; in shape it is perfectly adapted to the trochlear surface on the femur, whether the leg is flexed or extended; the femur moves on the patella, as the latter, owing to its ligament being inelastic, is stationary whenever the quadriceps extensor contracts. From the shape of the articular surfaces just noticed, it will be seen that flexion and extension are the principal movements for which they are adapted; if the tibia be fixed, as in standing on one leg, the femur may be slightly rotated, the internal condyle turning on its axis in the corresponding glenoid cavity, as if moving on a pivot.

In examining the *parietes* of the knee-joint, it is better to divide them into *six parts* or *regions*, which require to be studied separately. By doing this, the student will be able to obtain a more satisfactory knowledge of the walls of this articulation. These parts are situated, one in front, two on each side, and one behind.

The *anterior region* contains, in the *upper* part of it, the tendon of the quadriceps extensor muscle, Fig. 260 (2), in the *middle* the patella (3), and in the *lower* part the ligamentum patellæ, and a considerable quantity of adipose substance (4). There are *two bursæ mucosæ* in this region; one between the patella and the integument, and the other between the ligamentum patellæ and the tibia, just above its tubercle (6).

The *lateral regions* consist of an *antero-lateral* and a *postero-*

lateral on each side. The first of these might very appropriately be called the *aponeurotic regions.* In the *outer one* the parietes consist of the fascia lata, which is prolonged downwards over every part of the knee, in this as well as in the other regions; and beneath the fascia lata, of a thick fibrous layer, which is expanded from the tendon of the vastus externus, and, proceeding downwards, is inserted into the tibia between its tubercle and the lower attachments of the external lateral ligaments; and, under this, of a layer of fibres which arise from the outer border of the patella, and, passing transversely outwards, are inserted into the outer surface of the external condyle of the femur. The parietes in the *inner antero-lateral region* are very nearly the same as in the one just described; instead of the vastus externus, the vastus internus sends off a layer of vertical fibres, which pass downwards to be inserted into the tibia between its tubercle and the internal lateral ligament; there is no difference in the arrangement of the layer of transverse fibres; they are attached to the inner border of the patella, and to the internal condyle of the femur. The parietes of the joint in these regions are interesting on account of its being in one or the other of them that the cavity is entered by instruments, either in cases of hydrops articuli, or of loose cartilages in the joint, requiring an operation; it is in these regions, also, that a bulging is first observed, denoting the presence of water in the joint.

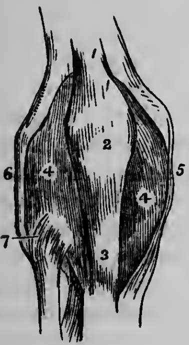
The parietes in the *postero-lateral regions* consist of the lateral ligaments. As these ligaments are unyielding, there are generally depressions in hydrops articuli corresponding to these regions. The tendons of the inner and outer hamstring muscles also correspond very nearly to them.

In the *posterior region* the parietes are formed by the ligamentum posticum. This is very deep seated, having the contents of the popliteal space placed between it and the external surface. When the cavity of the joint is opened, it should be studied in connection with these regions.

The *ligaments of the knee-joint* are divided into the *external* and *internal.* The former can be exposed without cutting into the cavity of the joint. By referring to the plates, the student will have no difficulty in ascertaining the exact position of each one. Their positions in the parietes of the joint have already been noticed. They will now be examined more particularly with reference to their appearance and attachments.

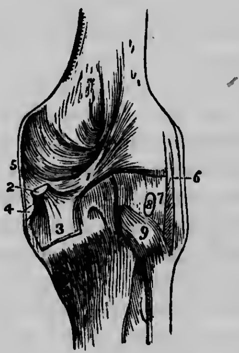
The LIGAMENTUM PATELLÆ, Fig. 257 (3), may be regarded as a continuation of the tendon of the quadriceps extensor cruris; so that, instead of arising from the patella, the latter might be considered a sesamoid bone developed in the tendon of the quadriceps muscle, of which the ligamentum patellæ would be the lower part. It is attached below to the tubercle of the tibia, where it is considerably narrower than it is at its attachment to the patella. It is about two inches in length. By observing its white, shining appearance, the dissector will have no difficulty in distinguishing it from the surrounding parts. Whether it be considered a ligament or not, it serves as the medium through which the above-mentioned muscle acts on the leg. When the cavity of the joint has been opened

Fig. 257.



AN ANTERIOR VIEW OF THE LIGAMENTS OF THE KNEE-JOINT.—1. The tendon of the quadriceps extensor muscle of the leg. 2. The patella. 3. The ligamentum patellæ, near its insertion. 4, 4. The synovial membrane. 5. The internal lateral ligament. 6. The long external lateral ligament. 7. The anterior superior tibio-fibular ligament.

Fig. 258.



A POSTERIOR VIEW OF THE LIGAMENTS OF THE KNEE-JOINT.—1. The fasciculus of the ligamentum posticum Winslowii, which is derived from 2, the tendon of the semi-membranosus muscle; the latter is cut short. 3. The process of the tendon which spreads out in the fascia of the popliteus muscle. 4. The process which is sent inwards beneath the internal lateral ligament. 5. The posterior part of the internal lateral ligament. 6. The long external lateral ligament. 7. The short external lateral ligament. 8. The tendon of the popliteus muscle, surrounded by synovial membrane. 9. The posterior superior tibio-fibular ligament.

and examined, the ligamentum patellæ should be divided a short distance below the patella, Fig. 259 (8), and its relations to the cavity and to the tibia carefully studied; a small *bursa*,

Fig. 259 (9), as was stated above, is usually found separating it, just above its insertion, from the tibia.

The External Long and Short Lateral Ligaments, Fig. 258 (6, 7), are situated on the outer side of the joint. The *long external lateral ligament* arises from the outer and back part of the external condyle of the femur, close to the origin of the popliteus, descends anterior to the tendon of the biceps, and is inserted into the outer part of the head of the fibula. The *short external lateral ligament* arises nearer the back part of the external condyle, close to the origin of the tendon of the external head of the gastrocnemius, passes downwards, and is inserted into the posterior part of the head of the fibula. It is smaller, shorter, and deeper seated than the long ligament. It is connected to the semilunar cartilage, and sometimes terminates in the coronary ligament. The inferior external articular artery passes beneath both of these ligaments, and they are separated from each other by a fasciculus of fibres derived from the tendon of the biceps.

The Internal Lateral Ligament, Fig. 258 (5), *arises* from the inner and posterior surface of the internal condyle of the femur, just below the insertion of the tendon of the adductor magnus. It passes downwards beneath the tendons of the sartorius, gracilis, and semi-tendinosus, from which it is separated by a bursa, to be inserted into the inner part of the head of the tibia. Its inner surface is in relation with the semilunar cartilage and synovial membrane above, and the inferior internal articular artery below. It is a broad, flat ligament, being much broader, however, below than above.

The Posterior Ligament or Ligamentum Posticum, Fig. 258 (1), is composed of fibres which cross the articulation behind in different directions; a large proportion of them, however, have an oblique direction from the inner and posterior part of the head of the tibia upwards and outwards to the external condyle of the femur; many of these fibres are continued from the tendon of the semi-membranosus, forming what has been called the *ligament of Winslow*. It forms the floor of the central part of the popliteal space. Anteriorly, it is in relation with the semilunar cartilages, synovial membrane, and the inter-condyloid notch. It is perforated by one or more foramina, for the transmission of the middle articular

artery, or arteries when there is more than one. It is difficult to make a clean dissection of this ligament, on account of the fat usually found intermixed with its fibres.

To examine the *interior of the knee-joint*, a semilunar incision should be made, with its concavity looking downwards, through the tendon of the quadriceps extensor muscle and the synovial membrane, about an inch above the patella, and extending laterally to the lateral ligaments. Having made the incision, and turned the patella downwards, with the leg semi-flexed, a beautiful view of the interior of the joint is presented. The following parts should now be observed:—

First, the prolongation of the synovial membrane upwards into a sort of *pouch*, between the tendon of the quadriceps extensor and the anterior surface of the femur, Fig. 260 (8). This should be carefully noted with reference to wounds penetrating the cavity of the joint. The extension of the synovial membrane upwards varies from an inch and a half to three inches, the difference being caused by the position of the leg as it regards flexion and extension; when the leg is flexed, it is not more than an inch and a half or two inches, but is increased to two inches and a half or three inches when the leg is extended. Hence, to determine whether a wound situated two inches or a little more above the patella, has penetrated the cavity of the joint or not, it is necessary to ascertain the position of the leg at the time the wound was inflicted.

Second, three folds of synovial membrane between the intercondyloid notch and the upper part of the ligamentum patellæ should be noticed. The *middle one* contains a few ligamentous fibres, and has been named the *ligamentum mucosum*, Fig. 260 (10). The *two lateral folds*, which are frequently quite indistinct, contain adipose substance; they have been called, without any good reason, the *ligamenta alaria*, Fig. 260 (9). The use of the ligamentum mucosum is to hold the ligamenta alaria *in sitû*, and thus prevent them from being pinched by getting between the articular surfaces of the bones. From the ligamentum mucosum, the synovial membrane is generally reflected backwards to the crucial ligaments, so as to form a sort of septum dividing the posterior part of the cavity into a right and left portion.

Dividing this fold, together with the ligamentum mucosum and also the ligamentum patellæ, just below its upper attach-

ment, the space between the lining membrane of the joint and the ligamentum patellæ should be examined. It will be found to contain adipose substance, Fig. 260 (7), and the anastomosis between the external and internal inferior articular arteries. It will be noticed that this space extends downwards between the head of the tibia and the ligamentum patellæ, and that there is at the lower part of it a bursa, Fig. 259 (9), Fig. 260 (6), placed between the ligament and the bone. This space should be studied with reference to wounds penetrating the cavity of the joint, either directly through the ligamentum patellæ or on either side of it. It will be observed that the adipose substance in this space is pressed backwards by the ligamentum patellæ when the leg is flexed.

To examine the reflections of the *synovial membrane* in the *posterior lower part* of the cavity, a vertical section of the entire joint should be made, as represented in Fig. 260, or one should be made of the femur and patella, down to the space between the semilunar cartilages on the head of the tibia. It will be found, when traced on the condyles, to extend upwards a short distance beyond their articular surfaces, extending a little further up on the inner than on the outer condyle. In the *posterior part* of the joint, it covers, on the outer side, the anterior surface of the ligamentum posticum and the outer head of the gastrocnemius, and also the tendon of the popliteus, Fig. 258 (8), on which it is prolonged to the superior articulation of the tibia and fibula, with the synovial membrane of which it is sometimes connected, so as to form a communication between that and the knee-joint. On the inner side, it covers the anterior surface of the ligamentum posticum and inner head of the gastrocnemius. In the *central part* of the joint behind, it is reflected upon the sides of the crucial ligaments, while opposite to these laterally, it covers the lateral ligaments. In the *lower part* of the joint, it is reflected over both the upper and lower surfaces of the semilunar cartilages, and also over the articular surfaces on the head of the tibia. Masses of adipose substance are observed in different parts of the knee-joint; they are contained in folds of the synovial membrane, and present different shapes; they have been called the *synovial fringes;* they have also been compared to the appendices epiploicæ on the colon; they are even found in subjects which are greatly emaciated.

Having traced the synovial membrane in every part of the

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joint, the lateral and posterior ligaments may be divided, or removed, for the purpose of exposing the crucial ligaments; it is better to divide them, just above the convex borders of the semilunar cartilages, so that the connection between them and these cartilages may be preserved. The synovial membrane is easily detached from the crucial ligaments. These ligaments are two in number; as their common name implies, they cross each other; they are named separately the *anterior* or *external*, and the *posterior* or *internal*. From their size and arrangement, they contribute largely to the strength of the knee-joint, in the central and posterior part of which they are placed.

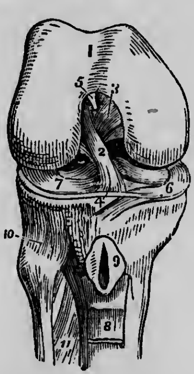
The ANTERIOR OR EXTERNAL CRUCIAL LIGAMENT, Fig. 259 (2), arises from the tibia just in front of the spine, between the glenoid cavities, and passes upwards, outwards, and backwards, to be inserted into the inner and posterior part of the external condyle.

The POSTERIOR OR INTERNAL CRUCIAL LIGAMENT, Fig. 259 (3), is somewhat larger, and more vertical in its direction than the anterior; it arises from the tibia just behind the spine, and passes upwards and slightly forwards, to be inserted into the outer part of the internal condyle. It is placed between the anterior crucial and the ligamentum posticum; it is best seen from behind, when the latter ligament has been removed, while the anterior one is best seen from before. Each ligament is connected at its origin with one of the semilunar cartilages; the anterior with the anterior cornu of the internal, and the posterior with the posterior cornu of the external semilunar cartilage. They limit the rotation of the tibia inwards, but not outwards; and prevent too great extension of the leg on the thigh; they also oppose abduction or adduction of the leg. The crucial ligaments may now be divided, and the semilunar fibro-cartilages with the ligaments which are connected to them for the purpose of keeping them *in sitû*, may now be examined.

There are two fibro-cartilages in the knee-joint, the INTERNAL and EXTERNAL, called SEMILUNAR, from their shape; they are placed, one between each of the glenoid cavities and its corresponding condyle. Each presents a thick convex outer border, and a thin concave margin which looks towards the centre of the joint, where a small portion of the articular

surface of the tibia is not covered with this fibro-cartilage. Although these are *interarticular fibro-cartilages*, they differ from those of other joints, as they do not form a septum

Fig. 259.



The Right Knee-Joint laid open from the front, in order to show the Internal Ligaments.—1. The cartilaginous surface of the lower extremity of the femur with its two condyles; the figure 5 rests upon the external; the figure 3 upon the internal condyle. 2. The anterior crucial ligament. 3. The posterior crucial ligament. 4. The transverse ligament. 5. The attachment of the ligamentum mucosum; the rest has been removed. 6. The internal semilunar fibro-cartilage. 7. The external semilunar fibro-cartilage. 8. A part of the ligamentum patellæ turned down. 9. The bursa, situated between the ligamentum patellæ and the head of the tibia; it has been laid open. 10. The anterior superior tibio-fibular ligament. 11. The upper part of the interosseous membrane; the opening in this membrane is for the passage of the anterior tibial vessels.

which divides the cavity into two compartments, but are covered on both sides with the same synovial membrane.

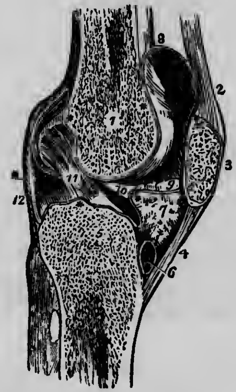
The Internal Semilunar Fibro-Cartilage, Fig. 259 (6), is placed on the internal glenoid cavity of the tibia, and is applied by its superior surface to the internal condyle of the femur. Its borders terminate in an anterior and a posterior cornu, which are attached to the head of the tibia, one before and the other behind the spine; the anterior cornu is connected to the anterior crucial ligament. The internal lateral and posterior ligaments are in apposition with its convex border. The synovial membrane is continuous from one surface to the other over its thin concave margin.

The External Semilunar Fibro-Cartilage, Fig. 259 (7),

is placed between the external glenoid cavity of the tibia and the external condyle of the femur; it is broader laterally than the internal, but not so long, being more round, which is owing to its attachments to the tibia being so close to each other; like the internal, its upper surface is more concave than the lower. Its cornua are attached to the tibia, one in front and the other behind the spine, but between the attachments of the cornua of the internal cartilage. The posterior cornu is connected to the posterior crucial ligament. Its attached, or thick, convex border is in apposition with the posterior and the external lateral ligaments, and the tendon of the popliteus muscle.

The semilunar fibro-cartilages are retained *in sitû* by liga-

Fig. 260.



A Longitudinal Section of the Left Knee-Joint, showing the Reflection of its Synovial Membrane.—1. The cancellated structure of the lower part of the femur. 2. The tendon of the extensor muscles of the leg. 3. The patella. 4. The ligamentum patellæ. 5. The cancellated structure of the head of the tibia. 6. A bursa situated between the ligamentum patellæ and the head of the tibia. 7. The mass of fat projecting into the cavity of the joint below the patella. ** The synovial membrane. 8. The pouch of synovial membrane which ascends between the tendon of the extensor muscles of the leg, and the front of the lower extremity of the femur. 9. One of the alar ligaments; the other has been removed with the opposite section. 10. The ligamentum mucosum left entire; the section being made to its inner side. 11. The anterior or external crucial ligament. 12. The posterior ligament. The scheme of the synovial membrane, which is here presented to the student, is divested of all unnecessary complications. It may be traced from the sacculus (at 8), along the inner surface of the patella; then over the adipose mass (7), from which it throws off the mucous ligament (10); then over the head of the tibia, forming a sheath to the crucial ligaments; then upwards along the posterior ligament and condyles of the femur to the sacculus, whence its examination commenced.

mentous fibres, which connect the convex border of each to the corresponding portion of the parietes of the joint; these fibres constitute the *coronary ligaments*, there being one for each of the fibro-cartilages. A fasciculus of fibres extends from one cartilage to the other in front, and assists in preventing them from being forced outwards; they form the *transverse ligament*, Fig. 259 (4). The cornua consist almost wholly of fibres which have been, where they are attached to the bone, named the *oblique ligaments.*

It will be observed that only two of the internal ligaments of this joint are intended to connect the femur to the tibia, and to contribute directly to the strength of the articulation; while the others are connected with the synovial membrane and the fibro-cartilages; the latter may, at a casual glance, appear to be unimportant, but when properly considered, they will be found to be essential to the perfection of the joint. If, for instance, the ligamenta alaria are necessary parts of the joint, then the ligamentum mucosum is requisite to keep them in their proper place. The same is true of the semilunar fibro-cartilages and the ligamentous fibres provided for keeping them *in sitû.*

Having completed the dissection of the knee-joint, the *superior tibio-fibular articulation* may be examined next. It is formed by a small oval articular facet on the outer and posterior part of the head of the tibia, and a corresponding one on the head of the fibula; both of these facets are covered with articular cartilage and with synovial membrane, which lines the parietes of the joint, forming a sac which sometimes communicates with the cavity of the knee-joint. The fact of a communication sometimes existing between this articulation and the knee-joint, should be recollected in a case of disarticulation of the head of the fibula. Although ligamentous fibres surround the articulation, so as to form an imperfect capsular ligament, they may be described as forming an *anterior* and a *posterior ligament.*

The ANTERIOR SUPERIOR TIBIO-FIBULAR LIGAMENT, Fig. 259 (10), consists of a broad, flat fasciculus, which arises from the anterior part of the head of the fibula, and passes obliquely upwards and forwards, to be inserted into the anterior and outer part of the tibia.

The POSTERIOR SUPERIOR TIBIO-FIBULAR LIGAMENT, Fig.

258 (9), is not so large as the anterior. It arises from the posterior part of the head of the fibula, and passes upwards and backwards, to be inserted into the outer and posterior part of the head of the tibia. The mobility allowed by this articulation is very limited; the head of the fibula may move slightly backwards or forwards, or separate a very little from the tibia.

The INTEROSSEOUS LIGAMENT OR MEMBRANE, Fig. 261 (2), which connects the shafts of the tibia and fibula, forms a septum between, or a floor for, the anterior and posterior interosseous fossæ. It corresponds to the one between the radius and ulna of the forearm. It is composed principally of fibres which pass obliquely downwards and outwards, from the outer angle of the tibia to the inner part of the fibula; a few fibres will be observed crossing these. An opening is observed in the upper part of it for the passage of the anterior tibial vessels; and another at the lower part, or about an inch above the inferior tibio-fibular articulation, for the transmission of the anterior division of the peroneal artery and its venæ comites. Both of its surfaces, as has been observed, are occupied by the origins of muscles. This ligament is sometimes called the great or superior interosseous ligament, to distinguish it from the small or inferior interosseous ligament which connects the lower extremities of the bones together.

Fig. 261.

The *inferior tibio-fibular articulation* is formed by a vertical, concave, rough surface on the outer part of the lower end of the tibia, into which the lower end of the fibula is received. Instead of having articular cartilage, covered by synovial membrane, as

A PART OF THE FEMUR, THE PATELLA, THE BONES OF THE LEG, AND A RANGE OF THOSE OF THE FOOT OF THE LEFT SIDE ARE VIEWED IN FRONT. Some ligaments of the knee-joint are distinguishable.—1. Superior anterior tibio-fibular ligament. 2. Interosseous membrane. 3. Inferior anterior tibio-fibular ligament. 4. Deltoid of ankle-joint. 5. Middle division of external lateral; and 6, anterior division of same. 7. Anterior ligament of ankle-joint.

in the superior articulation, the articular surfaces here are occupied principally by ligamentous fibres, which form the *small* or *inferior interosseous ligament.* Besides this ligament, they are connected by an *anterior*, a *posterior*, and a *transverse ligament.*

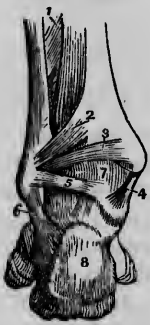
The Anterior Inferior Tibio-Fibular Ligament, Fig. 261 (3), arises from the outer part of the lower end of the fibula, passes upwards and inwards, spreading out so as to become quite broad, and is inserted into the outer and anterior part of the lower end of the tibia. It is composed of shining, parallel fibres which extend below the articular surfaces, so as to increase the depth of the cavity into which the astragalus is received.

The Posterior Inferior Tibio-Fibular Ligament, Fig. 262 (2), consists of a fasciculus of fibres which arises from the posterior and lower part of the fibula, and passes obliquely upwards and inwards, to be inserted into the posterior and lower part of the tibia. It is not so large as the preceding ligament.

The Transverse Tibio-Fibular Ligament, Fig. 262 (3), arises from the fibula, below the origin of the posterior ligament, and, passing nearly transversely inwards, is inserted into the posterior part of the internal malleolus. It increases the depth of the cavity formed by the tibia and fibula for the reception of the astragalus.

The Small or Inferior Interosseous Ligament consists of fibres, intermixed with some adipose substance, which pass from the articular surface of one bone directly to that of the other. It is concealed by the anterior and posterior ligaments, which must be divided in order to bring it into view, both from behind and before. It adds greatly to the strength of this articula-

Fig. 262.



A Posterior View of the Ligaments of the Ankle-Joint.—1. The lower part of the interosseous membrane. 2. The posterior inferior tibio-fibular ligament. 3. The transverse tibio-fibular ligament. 4. The internal lateral ligament. 5. The posterior fasciculus of the external lateral ligament. 6. The middle fasciculus of the external lateral ligament. 7. The synovial membrane of the ankle-joint. 8. The os calcis.

tion, which is probably stronger than if both bones were connected at their lower extremities by osseous matter, so as to form but a single piece. Articular cartilage covered with synovial membrane, extends a very short distance upwards between these bones.

The *tibio-tarsal articulation*, or *ankle-joint*, is formed by the tibia and fibula above and on the sides, and the astragalus below and in the centre; it belongs to the class of ginglymoid articulations. The tibia presents a horizontal, concave surface with an antero-posterior ridge, and also a vertical surface on the outer side of the internal malleolus, while the fibula also furnishes a vertical surface on the inner side of the external malleolus. The astragalus presents two vertical surfaces, one for each of the malleoli, and another which is concave transversely, and convex antero-posteriorly. These surfaces are covered with articular cartilage and synovial membrane. They allow of flexion and extension, and considerable lateral movement. The ligaments of this joint consist of an *internal* and an *external lateral*, and an *anterior* and a *posterior ligament*. These ligaments, taken together, form a sort of a capsular ligament, with the fibres accumulated principally on the sides, constituting the lateral ligaments.

The External Lateral Ligament, Fig. 264 (6, 7, 8), connects the fibula with the astragalus and os calcis. It consists of three distinct fasciculi, which radiate from the external malleolus. The *anterior* passes forwards and downwards, to be inserted into the anterior and outer part of the astragalus; it is broader at its insertion than at its origin, and it is shorter than the other two. The *posterior* passes backwards and slightly downwards, to be inserted into the inner and posterior part of the astragalus; it is composed of parallel fibres arranged in several layers, being the strongest of the three fasciculi; the transverse tibio-fibular ligament is placed just above it. The *middle fasciculus* arises from the lower extremity of the external malleolus, between the origins of the other two, and passes downwards and a little backwards, to be inserted into the outer and middle part of the os calcis; the tendons of the long and short peronei muscles pass over it.

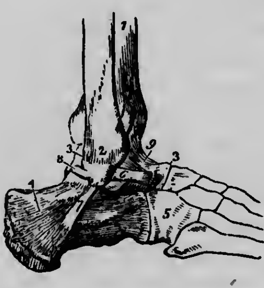
The Internal Lateral or Deltoid Ligament, Fig. 263 (6), consists of a *superficial* and a *deep layer*. The former

arises narrow from the inner and lower part of the internal malleolus, and, spreading out, passes downwards, some of its fibres being directed forwards, to be inserted into the os calcis

Fig. 263.

An Internal View of the Ankle-Joint—Right Leg.—1. The internal malleolus of the tibia. 2, 2. Part of the astragalus; the rest is concealed by the ligaments. 3. The os calcis. 4. The scaphoid bone. 5. The internal cuneiform bone. 6. The internal lateral or deltoid ligament. 7. The anterior ligament. 8. The tendo-Achillis; a small bursa is seen interposed between the tendon and the tuberosity of the os calcis.

Fig. 264.



An External View of the Ankle-Joint—Right Leg.—1. The tibia. 2. The external malleolus of the fibula. 3, 3. The astragalus. 4. The os calcis. 5. The cuboid bone. 6. The anterior fasciculus of the external lateral ligament attached to the astragalus. 7. Its middle fasciculus attached to the os calcis. 8. Its posterior fasciculus attached to the astragalus. 9. The anterior ligament of the ankle-joint.

and scaphoides. The latter arises immediately below the former, and is inserted into the astragalus. The tendons of the long flexors of the toes and the tibialis posticus pass over and partly conceal the lower and posterior part of this ligament.

The Anterior Ligament, Fig. 263 (7), is broad but very thin; it arises from the lower and anterior part of the tibia, and passes downwards and forwards to be inserted into the astragalus. It is covered by the tendons of the muscles which pass down in front of the ankle-joint. Some care is requisite to preserve the fibres which compose this ligament.

A *posterior ligament* of the ankle-joint can hardly be said to exist; its place is mainly, if not wholly, supplied by the transverse tibio-fibular ligament and the posterior fasciculus of the external lateral ligament. A good deal of adipose substance is found outside of the synovial membrane, both in

front of, and behind, the ankle-joint; and, in removing it, the student must be careful, or he will cut through the *synovial membrane*, Fig. 262 (7), which is quite loose in these places, especially in front, and expose the interior of the joint, Fig. 265 (9), before he desires to do so.

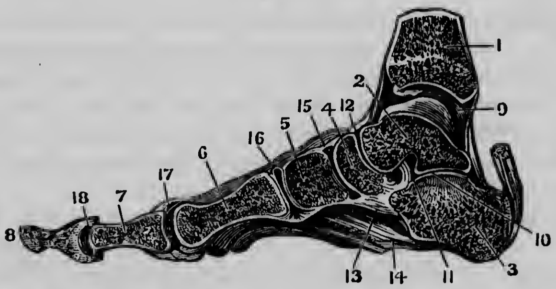
Perhaps no joint in the body is more liable to injury than the ankle-joint, hence the importance of a thorough knowledge of it to the student. It should be studied with reference to luxations, fractures, and sprains. The malleoli form prominent points, which can always be distinctly seen and felt in the living subject. Their position in relation to the other parts should be carefully noted, as they will be important guides in determining whether, in cases of injury or disease, displacement of any part or parts has occurred, and, if so, its character and extent, and also whether in the treatment the parts displaced have been restored to their proper place.

The *tarsal ligaments*, like those of the carpus, are numerous; and while it is scarcely expected that the student will have the time to become familiar with all, he should not neglect to acquire a thorough knowledge of some of them. A knowledge of the tarsal and the tarso-metatarsal articulations is indispensable to any one who shall have occasion to disarticulate the metatarsus, as in Hey's operation, or a portion of the tarsus, as in Chopart's operation. As every physician is liable to have cases of inflammation of these joints and its sequelæ, or of injuries not requiring, as a dernier resort, or at least not immediately, amputation of a portion of the foot, every student should avail himself of the opportunities afforded him in the dissecting-room to carefully examine and study the structure of the foot. Although it may be the last part of the limb to be dissected, it is none the less important. After dissecting the muscles, vessels, and nerves of the whole, or any part of it, he should keep it wet until he has time to examine all the articulations, which he can easily do with the aid of his book and plates.

Having severed the ligaments which connect the tibia and fibula with the tarsus, and dissected off all the soft parts which cover the bones and ligaments of the foot, the ligamentous connections of the tarsus may be examined first. Of these, the connections of the astragalus are, from its position, its function, and liability to displacement, perhaps, the

most important. It is connected to the os calcis by three ligaments, the *interosseous*, the *posterior*, and the *external.*

Fig. 265.



A Vertical Section of the Ankle-Joint and Foot of the Right Side.—1. The tibia. 2. The astragalus. 3. Os calcis. 4. The scaphoides. 5. The cuneiforme internum. 6. The metatarsal bone of the great toe. 7. The first phalangeal bone of the great toe. 8. The second phalangeal bone of the great toe. 9. The articular cavity between the tibia and astragalus, with its articular adipose substance. 10. The synovial capsule between the astragalus and os calcis. 11. The calcaneo-astragaloid interosseous ligament. 12. The synovial capsule between the astragalus and scaphoides. 13. The calcaneo-scaphoid ligament. 14. The calcaneo-cuboid ligament. 15. The synovial capsule between the scaphoides and cuneiforme internum. 16. The synovial capsule between the cuneiforme internum and the first metatarsal bone. 17. The metatarso-phalangeal articulation of the great toe, with the sesamoid bones below. 18. The phalangeal articulation of the great toe.

The Interosseous Ligament, Fig. 265 (11), is placed in a canal formed by a transverse groove on the under surface of the astragalus, and a corresponding one on the upper surface of the os calcis. It is a short, but very strong ligament, forming the principal ligamentous connection between these bones. Its fibres have more or less adipose substance intermixed with them. To obtain a good view of this ligament, a vertical section of the astragalus and os calcis should be made, so as to divide the ligament in an antero-posterior direction. These bones articulate with each other by mutual reception; the astragalus presents two articular surfaces; a concave one placed behind the groove, and a convex one anterior to the groove, while the os calcis presents two corresponding articular facets. The articulation, posterior to the groove, has a distinct *synovial capsule*, Fig. 265 (10), while the *synovial capsule* (12) of the articulation in front of the

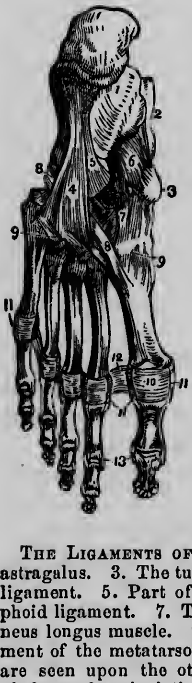
groove is prolonged into the articulation formed by the astragalus and the scaphoides.

The POSTERIOR LIGAMENT extends from the posterior part of the astragalus to the upper part of the os calcis.

The EXTERNAL LATERAL LIGAMENT arises from the outer and under surface of the astragalus, and passes downwards beneath the middle fasciculus of the external lateral ligament, to be inserted into the outer part of the os calcis. The sheaths of the tendons of the long muscles which pass along the inner side of the os calcis, supply the place of an internal ligament.

The astragalus is connected to the scaphoides by the *astragalo-scaphoid ligament.* To understand properly the articulation of the astragalus with the scaphoid bone the external and inferior calcaneo-scaphoid ligaments should be considered.

Fig. 266.



The ASTRAGALO-SCAPHOID LIGAMENT arises from the anterior and upper part of the astragalus, and passes forwards to be inserted into the upper surface of the scaphoid bone; it consists of a broad band of parallel fibres which cover in the articulation on the dorsum of the foot. It is covered by the tendons of the extensor muscles of the toes, and also by that of the tibialis anticus.

The articulation of the astragalus with the scaphoid bone belongs to the class of enarthrodial joints, and is similar to that formed by the os magnum and the first row of bones in the carpus. It allows of a much greater degree of mobility than any other articulation in the tarsus, being a ball and socket joint. The cavity into

THE LIGAMENTS OF THE SOLE OF THE LEFT FOOT.—1. The os calcis. 2. The astragalus. 3. The tuberosity of the scaphoid bone. 4. The long calcaneo-cuboid ligament. 5. Part of the short calcaneo-cuboid ligament. 6. The calcaneo-scaphoid ligament. 7. The plantar tarsal ligaments. 8, 8. The tendon of the peroneus longus muscle. 9, 9. Plantar tarso-metatarsal ligaments. 10. Glenoid ligament of the metatarso-phalangeal articulation of the great toe; similar ligaments are seen upon the other toes. 11, 11, 11. Lateral ligaments of the metatarso-phalangeal articulations. 12. Transverse ligament. 13. The lateral ligaments of the phalangeal bones of the great toe; similar ligaments are seen upon the other toes.

which the head of the astragalus is received is formed partly by the inferior calcaneo-scaphoid ligament, which not only supports the head of the astragalus, but assists in keeping it applied to the glenoid cavity of the scaphoid bone. The *synovial membrane*, Fig. 265 (12), of this joint is, as was before stated, continuous with the one in the anterior articulation of the astragalus and os calcis.

The os calcis is connected to the scaphoid and cuboid bones by several ligaments; with the cuboid it is connected by a *superior*, an *inferior*, and an *interosseous ligament*, and with the scaphoid bone by two, the *external calcaneo-scaphoid*, and the *inferior calcaneo-scaphoid ligament.*

The SUPERIOR CALCANEO-CUBOID LIGAMENT arises from the anterior and superior part of the os calcis, and passes forwards to be inserted into the superior and posterior surface of the cuboid bone.

The INFERIOR CALCANEO-CUBOID LIGAMENT consists of two fasciculi, a *long* or *superficial*, Fig. 266 (4), and a *short* or *deep-seated fasciculus* (5). The former is also called the *long plantar ligament.* They both arise from the under surface of the os calcis, but have very different insertions. The long fasciculus extends forwards, to be inserted, partly into the cuboid bone, and partly into the bases of the fourth and fifth metatarsal bones; it passes over and binds to the bone, the tendon of the peroneus longus muscle. The short or deep-seated fasciculus is inserted into the under surface of the cuboid bone, being covered by the long one below, and lying next to the bone above.

The INTEROSSEOUS or INTERNAL CALCANEO-CUBOID LIGAMENT arises from the groove in the os calcis and passes forwards, to be inserted into the inner and posterior part of the cuboid bone. It is quite a short, but a strong ligament.

The EXTERNAL CALCANEO-SCAPHOID LIGAMENT arises from the os calcis close to the origin of the internal calcaneo-cuboid, and from its deep situation at its origin might, as well as that, be called an interosseous ligament. It is inserted into the upper and outer part of the scaphoid bone.

The INFERIOR or PLANTAR CALCANEO-SCAPHOID LIGAMENT, Fig. 266 (6), arises from the anterior and lower part of the os calcis, and passes forwards to be inserted into the

under surface of the scaphoid bone. It is considerably larger than the preceding ligament. Its upper surface is partly covered by the synovial membrane of the astragalo-scaphoid articulation, of which it may be regarded as forming a part.

From the dissection that has now been made, the student will be able to see what ligaments must be lacerated, when the *astragalus is luxated*, and also what ligaments must be divided in *Chopart's operation*, in which the scaphoid and cuboid bones are disarticulated from the astragalus and os calcis. He has also seen *three* of the *four synovial membranes* or *sacs* which are found in the tarsus. Fig. 265 (10, 12, 15, 16).

The remaining five bones of the tarsus are connected by *dorsal*, *plantar*, and *interosseous ligaments*. It is not necessary to describe each one of these separately. With a little care and patience, the student will have little or no difficulty in finding them.

The SCAPHOID BONE is connected to the cuboid by a *dorsal*, an *interosseous*, and a *plantar ligament*, all of which have a transverse direction. Sometimes there are one or two small synovial membranes between these bones, which are held very firmly together by their ligaments.

The SCAPHOID BONE is connected to the three cuneiform bones by *four dorsal ligaments;* one for each, except the internal, which has two, one of which is placed on the inner side of the articulation, and is called the *internal scaphoideo-cuneiform ligament;* it is also connected by *three plantar ligaments*, the principal one of which connects it to the internal cuneiform, and is blended with the tendon of the tibialis posticus. The *synovial membrane*, Fig. 265 (15), between the scaphoid and cuneiform bones, is continuous with those found between the latter bones.

The CUBOID BONE is joined to the external cuneiform bone by a *dorsal*, a *plantar*, and an *interosseous ligament*. These ligaments have a transverse direction. The plantar one is very small.

The CUNEIFORM BONES are connected to each other by *dorsal*, *plantar*, and *interosseous ligaments*. Of these, the interosseous are the strongest. The plantar are very small. The *fourth synovial membrane* of the tarsus is common to the articulations of the cuboid with the external cuneiform,

to the scaphoid with the three cuneiform, and to the cuneiform with each other. The same synovial membrane is also prolonged forwards between the cuneiform bones and the first, second, and third metatarsal bones. Fig. 265 (16).

The Tarso-Metatarsal Articulation is formed by the cuboid and the three cuneiform bones, and the five metatarsal bones. The middle cuneiform bone is shorter than the other two, and hence the second metatarsal bone projects backwards between the internal and external cuneiform. In disarticulating the metatarsus from the tarsus, as in *Hey's operation*, it is important to recollect this arrangement. It will be seen that the internal cuneiform articulates with the first and second metatarsal, the second cuneiform with the second metatarsal, and the third cuneiform with the second and third metatarsal, while the cuboid is joined to the fourth and fifth metatarsal bones. These articulations allow some degree of mobility, especially when considerable force is used, as in jumping and leaping. The same is true of the articulations between the anterior five bones of the tarsus. Although the motion allowed by any single one of these articulations is very little, in the aggregate it amounts to considerable.

The *tarsus* is joined to the *metatarsus* by *dorsal*, *plantar*, and *interosseous ligaments*. Each metatarsal bone, except the second, is connected to the tarsal bone with which it articulates by a dorsal ligament; the second is joined to each of the three cuneiform bones by a dorsal ligament, and to each of the internal and middle by a plantar ligament. The articulation of the first metatarsal bone is strengthened by fibres derived from the insertion of the tendons of the tibialis anticus and peroneus longus. The fourth and fifth metatarsal bones obtain their plantar ligaments from fibres derived from the sheath of the peroneus longus. The tendon of the peroneus brevis and the external division of the plantar aponeurosis assist in keeping the fifth metatarsal bone in its place. The interosseous ligaments are placed between the bones which they connect.

The Metatarsal Bones are connected together at their tarsal extremities by three sets of ligaments, *dorsal*, *interosseous*, and *plantar*. The interosseous are very strong, passing directly from one bone to another. The dorsal and plantar ligaments

also have a transverse direction. At their phalangeal extremities they are connected by a *transverse ligament.* Fig. 266 (12).

The METATARSAL BONES are connected to each of the phalangeal bones by *two lateral*, and *one glenoid ligament* for each articulation. Fig. 266 (10, 11). The *tendons* of the extensor muscles of the toes supply the place of the *dorsal ligaments.* The glenoid ligaments are dense, like fibro-cartilage. There is one placed below each articulation, the edges of which are continuous with the lateral ligaments, and also with the sheath of the corresponding tendons of the common flexor muscles of the toes. Each also assists in forming the cavity for the reception of the head of the corresponding metatarsal bone. The lateral ligaments are very strong; each one, as well as the glenoid ligament, is connected with the digital processes of the plantar aponeurosis.

The PHALANGEAL BONES are connected together by means of *one glenoid* and *two lateral ligaments*, Fig. 266 (13), for each joint. The glenoid ligament has the same arrangement as in the preceding articulation, and the lateral ligaments also have the same attachments and the same relations as in that joint. As in the metatarso-phalangeal articulations, there are no dorsal ligaments, the *tendons* of the *extensor muscles* supplying their places. There is nothing connected with the synovial membranes in these articulations that requires any notice.

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THE END.

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